6573-29

The American Journal of Surgery

Editor ROBERT M. ZOLLINGER, M.D., *Columbus, Ohio*

EDITOR EMERITUS

THURSTON SCOTT WELTON, M.D., *Brooklyn, New York*

ADVISORY BOARD

HENRY T. BAHNSON, M.D., *Baltimore;* JOHN M. BEAL, M.D., *New York;* CLAUDE S. BECK, M.D., *Cleveland;* H. GLENN BELL, M.D., *San Francisco;* CLARENCE J. BERNE, M.D., *Los Angeles;* B. MARDEN BLACK, M.D., *Rochester, Minn.;* CHARLES GARDNER CHILD, III, M.D., *Ann Arbor;* RANDOLPH LEE CLARK, JR., M.D., *Houston;* H. WILLIAM CLATWORTHY, JR., M.D., *Columbus;* FREDERICK A. COLLER, M.D., *Ann Arbor;* HERBERT CONWAY, M.D., *New York;* OSCAR CREECH, JR., M.D., *New Orleans;* GEORGE J. CURRY, M.D., *Flint;* J. ENGLEBERT DUNPHY, M.D., *Portland;* DANIEL W. ELLIOTT, M.D., *Columbus;* EDWIN H. ELLISON, M.D., *Milwaukee;* EGBERT H. FELL, M.D., *Chicago;* WILLIAM T. FITTS, JR., M.D., *Philadelphia;* D. P. HALL, M.D., *Louisville;* JAMES D. HARDY, M.D., *Jackson;* J. HARTWELL HARRISON, M.D., *Boston;* STANLEY O. HOERR, M.D., *Cleveland;* CHARLES A. HUFNAGEL, M.D., *Washington;* WALTER G. MADDOCK, M.D., *Chicago;* K. ALVIN MERENDINO, M.D., *Seattle;* CARL A. MOYER, M.D., *St. Louis;* WILLIAM H. MULLER, JR., M.D., *Charlottesville;* D. W. GORDON MURRAY, M.D., *Toronto;* MERLE M. MUSSELMAN, M.D., *Omaha;* SIDNEY W. NELSON, M.D., *Columbus;* T. B. QUIGLEY, M.D., *Boston;* VICTOR RICHARDS, M.D., *San Francisco;* JOHN A. SCHILLING, M.D., *Oklahoma City;* JOHN C. ULLERY, M.D., *Columbus;* ROGER D. WILLIAMS, M.D., *Columbus;* HAROLD A. ZINTEL, M.D., *New York*

VOLUME 99

JANUARY TO JUNE

1960

29090

THE AMERICAN JOURNAL OF SURGERY, INC.

11 EAST 36TH STREET, NEW YORK 16, N. Y.

MCMLX

COPYRIGHT, 1960
BY THE AMERICAN JOURNAL OF SURGERY, INC.
Subsidiary of The Reuben H. Donnelley Corporation

All Rights Reserved

Printed in the United States of America

LIBRARY
BOSTON UNIVERSITY
SCHOOL OF MEDICINE

Contents of Volume 99

Cooperation versus Conflict in the Surgical Pathology Consultation	*Alvin G. Foraker*	1
Elective Surgery for Duodenal Ulcer—A Graded Approach	*Stanley O. Hoerr*	4
An Experimental Study of Resection and Replacement of the Superior Vena Cava	*W. Marshall East* *William H. Muller, Jr.*	6
Insertion, with a Guide, of Multiple Nails in Fractures of the Femoral Neck	*Michael T. Modny* *Harold G. Kunz*	13
Sexual Potency in Aging Males. III. Technic of Avoiding Nerve Injury in Perineal Prostatic Operations	*Alex L. Finkle* *J. B. DeC. M. Saunders*	23
End Result Study of a Series of Operations for Herniated Intervertebral Lumbar Discs	*Frederick S. Webster* *D. P. Smiley*	27
Primary Tumors of the Small Intestine	*E. Meredith Alrich* *Richard H. Blank* *John J. Fomon*	33
Experimental Evaluation of Grafts in the Canine Inferior Vena Cava	*Harold A. Collins* *George Burrus* *Michael E. De Bakey*	40
Inguinal Hernia in Pediatric Patients	*Charles W. McLaughlin, Jr.* *John D. Coe*	45
The Inhibition of Russell's Viper Venom by the Water-Soluble Derivatives of Sodium-Copper Chlorophyllin	*Joseph M. Miller* *Deborah A. Jackson* *Charles S. Collier*	48
A Study of Ileal Substitution for the Creation of a Continent Urinary Bladder	*Charles L. Reynolds, Jr.*	50
Comparative Study of Bile Drainage in Dog and Man	*T. Ogawa* *N. C. Jefferson* *H. Necheles*	57
A Cannula for Biopsy of the Brain	*Roger M. Morrell*	63
A New, Rapid Technic for Taking X-ray Films During Surgery	*Stuart R. Jaffee*	68
Retroperitoneal Non-chromaffin Paraganglioma	*Robert T. Sessions* *H. William Scott, Jr.*	70
Gas Gangrene without Visible Portal of Entry	*William A. Whyland* *Murray N. Levin*	77
Retroperitoneal Pelvic Neurofibrosarcoma	*Denis Cavanagh* *Fernando Alonso-Lej*	80

Malignant Carcinoid Syndrome and Latest Concepts in Serotonin Metabolism. Use of Cortisone, Prednisone and Antiserotonin Compound 45-50	*Raimonds J. Gailitis* *Werner Scheiber*	84
False Aneurysm Due to an Infected Aortic Anastomosis. Successful Resection and Reanastomosis	*C. Burling Roesch* *James W. Bond*	90
Metastatic Melanoma of the Stomach	*Galen H. Davis* *Richard W. Zollinger*	94
Dermatofibrosarcoma Protuberans	*J. K. McGregor*	97
Huge Hiatal Hernia Associated with Acute Coronary Thrombosis	*Angelo Riberi* *Robert J. Hritzo*	100
Traumatic Rupture of the Gallbladder without a Penetrating Wound of the Abdominal Wall	*W. Clayton Davis* *John D. German*	103
Intussusception of the Vermiform Appendix	*Wilson Juca*	106
Surgery Court Cases	*Howard Newcomb Morse*	108
The Diagnostic Corner	*Sidney W. Nelson*	110, 114
Case Analysis Clinic	*Thomas L. Meyer, Jr.*	118
Case Analysis Clinic	*William R. C. Stewart*	120
Case Analysis Clinic	*Donald W. Trapbagen*	123
Our Surgical Heritage	*D. P. Hall*	127
Book Reviews		129
Introduction	*John J. Byrne*	133
Aganglionic Lesions of the Colon	*John H. Fisher* *Orvar Swenson*	134
Some Comments on the Surgical Treatment of Imperforate Anus. Long Term Results and Postoperative Management	*John E. S. Scott* *Orvar Swenson* *John H. Fisher*	137
The Management of Rectal Prolapse and Procidentia	*Neil W. Swinton* *Trevelyan E. Palmer*	144
The Role of Surgery in the Management of Ulcerative Colitis	*Charles B. Ripstein*	152
Hemorrhoids: Advances and Retreats	*Robert Turell*	154
Large Bowel Obstruction	*John J. Byrne*	168
Unusual Lesions of the Right Colon	*George Francis Miller*	179
Surgical Procedures for Carcinoma of the Left Colon and Rectum, with Five-Year End Results Following Abdominopelvic Dissection of Lymph Nodes	*Michael R. Deddish*	188
Surgical Treatment of Diverticulitis of the Sigmoid	*Reginald H. Smithwick*	192

The Story of Cholecystography	*Warren H. Cole*	206
The Surgical Implications of Unsuspected Ingested Foreign Bodies	*Oscar Serlin*, *George T. Wobl*	223
Roentgenographic Diagnosis of Structural Deviations in the Lumbosacral Spine of Persons Engaged in Heavy Industry	*Martin C. Lindem*, *Harry J. Brown*, *Boyd J. Larsen*, *J. R. Mitchell*	228
Diverticula of the Duodenum	*Gilman Deering Kirk*	233
Cushing's Disease	*Edward J. Carry*, *I. Walzer*	236
Epidermoid Cyst of the Spleen	*Harold Lewis*	242
Ureteral Metastasis Secondary to Carcinoma of the Large Bowel	*David B. Stearns*, *Stanley K. Gordon*	244
Localized Hodgkin's Disease of the Small Intestine	*S. Lloyd Teitelman*, *Norman R. Brill*	247
Spontaneous Rupture of the Cervical Portion of the Thoracic Duct	*Jesse Eisen*	249
Massive Hemorrhage from Sigmoid Diverticula	*Thomas L. Meyer*	251
Solitary Pulmonary Nodules	*James W. Quinn*	253
Surgery Court Cases	*Howard Newcomb Morse*	255
Our Surgical Heritage	*D. P. Hall*	257
The Diagnostic Corner	*Sidney W. Nelson*	260
Book Reviews		264
Respect the Skin	*Egbert H. Fell*	265
Adrenocortical Hyperfunction—Surgical Consideration	*Donald B. Butler*	266
Islet Cell Tumors of the Pancreas and Hyperinsulinism	*Frank A. Rogers*	268
Pneumatosis Cystoides Intestinalis. Report of Two Cases and Review of the Natural History of the Disease	*Robert M. Faggella, Jr.*, *James P. Dewar*, *John A. Schilling*	283
A Study of Pseudomembranous Enterocolitis	*Charles Pearce*, *Peter Dineen*	292
Dermatofibrosarcoma Protuberans. Review of the Literature and Report of Four Cases	*Bencel L. Schiff*, *Murray J. Tye*, *Arthur B. Kern*, *Giuseppe Moretti*, *Francesco Ronchese*	301

Hospital Use of Routine Sigmoidoscopy	*Alan B. Cameron*	307
Masses of the Rectovaginal Septum. A Proposed Classification, Review of the Literature and Report of a Case of Leiomyosarcoma	*Kent L. Brown* *Abraham J. Segal* *Gerald B. Hurd*	309
The Use of Darvon Compound after Anorectal Surgery	*Karl Zimmerman* *Robert S. Mechling* *Richard S. Omura*	316
Phytobezoars Occluding the Small Intestine Following Subtotal Gastrectomy	*Gunther W. Nagel* *Jerald J. Bergera*	318
Sarcomas of the Small Intestine. Report of Three Pathologic Types with Review of the Literature	*Yousif D. Al-Naaman*	320
The Use of Dry Ice Refrigeration When Delaying an Inevitable Amputation	*Melvin I. Gibbel* *Robert A. Atkins* *Arline Burns*	326
Ventral Hernia. A Rapid Method of Repair	*R. W. Crostbwait*	330
Operative Cholangiography Through a Foley Catheter During Exploration of the Common Duct	*Edward Gerber, Jr.* *Frederick Goethe Smith*	332
A Method of Tendon Repair	*Gordon Murray*	334
Disappearing Gallstones. A Lesson in Management of Patients with Gallstones	*Seymour Fiske Ochsner*	336
Chronic Idiopathic Jaundice	*Gerald S. Margulies* *Donald H. Finger*	339
Metastases in Cancer of the Cervix	*John T. Parente*	343
Hodgkin's Disease of the Breast	*J. K. McGregor*	348
Inflammatory Gastric Polyps (Eosinophilic Granulomas of the Stomach)	*Everett Carlson* *John Guy Ward*	352
Granulomatous Pseudoneoplastic Appendicitis	*John Grubn* *Frank Tetlow*	358
Massive Intraperitoneal Hemorrhage, A Complication of Disease of the Gallbladder	*John F. Raycroft* *Michael Mastrangelo*	361
Transfixion of the Aortic Valve with a Surgical Foreign Body	*John W. Bell*	364
Massive Bleeding Esophageal Varices Incident to Infectious Mononucleosis, Cirrhosis of the Liver and Portal Hypertension	*Joseph Hodge* *William Gorham*	369
Subarachnoid Hemorrhage	*James E. Barnes*	374
Osteomyelitis of the Lumbar Vertebral Body Following Drainage of a Subdiaphragmatic Abscess	*Richard F. Slager*	377
Surgery Court Cases	*Howard Newcomb Morse*	380

The Diagnostic Corner	*Sidney W. Nelson*	382
Our Surgical Heritage	*D. P. Hall*	386
Book Reviews		390
Introduction	*Edwin H. Ellison*	393
Hyperparathyroidism: Diagnosis and Management	*Oliver Cope*	394
Thymectomy for Myasthenia Gravis	*M. M. Musselman* *J. W. Porter*	404
Hyperinsulinism. Clinical and Surgical Aspects	*William H. ReMine* *Donald A. Scholz* *James T. Priestley*	413
Fibrogenic Mesodermal Tumors, An Unusual Cause of Hyperinsulinism	*Stanley R. Friesen* *Don R. Miller*	420
Ulcerogenic Tumors of the Pancreas	*Robert M. Zollinger* *Thomas V. Craig*	424
Management of Functioning Tumors of the Adrenal Cortex	*James D. Hardy* *Jasper L. McPhail*	433
Adrenalectomy for Cushing's Syndrome	*Henry Mannix, Jr.* *Richard Karl* *Frank Glenn*	449
Pheochromocytoma in the Adult and in the Child	*David M. Hume*	458
Anterior Transabdominal Adrenalectomy for Endocrine Disease	*Edwin H. Ellison*	497
Aldosterone	*Bernard Zimmermann* *Walter H. Moran*	503
The Effect of Endocrinectomy on Ascites with Especial Reference to Adrenalectomy and Thyroidectomy	*Ivan D. Baronofsky* *Jerome W. Canter*	512
A Review of Endocrine Tumors of the Ovary	*John C. Ullery*	519
Diagnosis and Treatment of Testicular Tumors	*Col. John F. Patton* *Capt. David N. Seitzman* *Capt. Robert A. Zone*	525
Endocrine Dependency of Tumors of the Thyroid	*George Crile, Jr.*	533
Hormonal Treatment of Metastatic Carcinoma of the Breast	*William H. Baker* *Rita M. Kelley* *William D. Sobier*	538
Hypophysectomy in the Treatment of Metastatic Mammary Cancer	*Olof H. Pearson* *Bronson S. Ray*	544
Oophorectomy and Adrenalectomy in Patients with Inoperable or Recurrent Cancer of the Breast	*Henry Thomas Randall*	553

A Survey of Total Adrenalectomy in Cancer of the Prostate	*David A. Macfarlane* *Lewis P. Thomas* *J. Hartwell Harrison*	562
Bilateral Orchiectomy in the Treatment of Carcinoma of the Prostate	*Vincent J. O'Conor* *J. Kenneth Sokol*	573
The Management of Endocrine Deficiencies of Surgical Origin	*William W. Engstrom* *Edward J. Lennon*	580
Current Status of Endocrine Homografts Using the Millipore Diffusion Chamber Technic	*John R. Brooks* *George J. Hill, II*	588
The Use of Anabolic Steroids in Surgical Patients	*John S. Bradshaw* *William E. Abbott* *Stanley Levey*	600
Book Reviews		608
Notes on a Visit to the U.S.S.R. to Observe Surgical Technics and Research, June 27–July 10, 1959	*Truman G. Blocker*	609
A Rational Approach to Classification and Treatment of Fractures of the Surgical Neck of the Humerus	*Theodore Drapanas* *John McDonald* *Harry W. Hale, Jr.*	617
Radial Nerve Injuries in Fractures of the Shaft of the Humerus	*Alexander Garcia, Jr.* *Benjamin H. Maeck*	625
Recurrent Anterior Dislocation of the Shoulder. I. Morbid Anatomy	*Harrison L. McLaughlin*	628
Football Injuries to the Shoulder Girdle	*Richard Patton*	633
The Treatment of Ruptures of the Distal Biceps Brachii Tendon	*J. Minton Meberin* *Eugene S. Kilgore, Jr.*	636
Management of Perforating Injuries to the Colon in Civilian Practice	*W. R. Roof* *George C. Morris, Jr.* *Michael E. De Bakey*	641
Non-penetrating Injuries to the Spleen	*D. Economy* *C. Koucky* *R. L. Novack*	646
Portal Hypertension as the Result of Penetrating Abdominal Trauma	*T. B. Patton* *C. G. Johnston*	651
Indications for Operation in Abdominal Trauma	*Gerald W. Shaftan*	657
Perforations of the Distal Large Intestine Produced by Intraluminal Traumas	*Wesley Furste* *Harvey Knoernschild*	665
Acid Debridement of Burned Rats and Men	*Nicholas S. Gimbel* *Frederick Weissman* *Joseph Schirle* *Aline U. Orten*	676

Early Management of Burns. Primary Excision and Heterografting with Early Autografting	*Lacy Stallings*, *Eric Kahn*, *Mitchell Goldenberg*, *I. H. Sokolic*, *John M. Howard*, *M. Winokur*	679
Dextran Therapy in Severe Burns. Results in 246 Cases	*B. W. Haynes, Jr.*	684
Relative Lack of Efficacy of Fluid Therapy. Comparison of Flash Burns and Scalds in Monkeys	*Charles L. Fox, Jr.*, *Sigmund E. Lasker*, *James M. Winfield*	690
A Different Concept of Volume Replacement in Traumatic Hypovolemia. Observations on Injured Man and Animal	*Morris J. Fogelman*, *Ben J. Wilson*	694
The Treatment of Acute Craniocerebral Injuries	*W. D. Hilst*, *Aage Nielsen*	702
Cranial Trephination for Diagnosis and Therapy in Closed Injuries to the Head. A Five-year Review	*David N. Kluge*	707
Glutamic Oxalacetic Transaminase in the Evaluation of Acute Injury to the Head	*S. E. Smith*, *K. V. Cammack*, *M. E. Dodds*, *G. J. Curry*	713
Oblique Motion Studies and Other Non-myelographic Roentgenographic Criteria for Diagnosis of Traumatized or Degenerated Lumbar Intervertebral Discs	*Martin S. Abel*, *Paul H. Harmon*	717
Chemical Osteosynthesis	*Irving Redler*	730
Chemical Osteosynthesis of Fractures and Nonunions of the Shafts of Long Bones of the Lower Extremity	*Benjamin W. Drompp*	733
The Use of Intramedullary Prosthetic Replacement in Fractures of the Femoral Neck	*Rolla D. Campbell, Jr.*, *Joseph B. Mason*, *Philip D. Wilson, Jr.*, *Preston A. Wade*	745
Separation of the Lower Femoral Epiphysis	*Charles S. Neer, II*	756
Circumferential Freeze-Dried and Frozen Bone Homografts Fixed with an Intramedullary Nail to the Femoral Shaft of the Dog	*Brooke Roberts*, *William T. Fitts, Jr.*, *Simon M. K. Myint*, *Jacques Jenny*, *Herndon B. Lebr*, *Lewis Anderson*, *T. Hunter Pryor*	762

Replacement of Bone Defects in Dogs by Experimental Soft Tissue Transplants. Preliminary Report	*Michael Sierp* *Paul W. Braunstein* *William Samellas* *John W. Draper*	766
Penetrating Wounds of the Aorta	*Arthur C. Beall, Jr.*	770
Surgical Experience with 220 Acute Arterial Injuries in Civilian Practice	*George C. Morris, Jr.* *Arthur C. Beall, Jr.* *W. R. Roof* *Michael E. De Bakey*	775
Pericardial Tamponade. Newer Dynamic Concepts	*J. Walter Martin* *Worthington G. Schenk, Jr.*	782
Gunshot Wounds of the Heart. A Review of Twenty Cases	*Herbert T. Ransdell, Jr.* *Henry Glass, Jr.*	788
Safe at Home	*John H. Powers* *S. Richard Prothero*	798
Cross Chest Flap Grafts	*William L. White*	804
Retrograde Flap—A Coverage Problem	*David W. Robinson* *Frank W. Masters* *Creighton A. Hardin*	809
Treatment of Fire Victims: Lady of the Angel School Disaster	*James J. Callahan* *James E. Segraves*	814
Rotary Power Mower Injuries	*William A. Johns* *Thomas R. Butterworth* *John H. Greig*	817
Fat Embolism: The Significance of an Elevated Serum Lipase after Trauma to Bone	*Leonard F. Peltier* *Federico Adler* *Sing-Ping Lai*	821
Experience with Intrathoracic Injury Following Automobile Accidents	*William G. Pace* *Edward Passaro, Jr.* *Karl P. Klassen*	827
Certain Considerations in the Use of Jejunum or Colon for Esophageal Substitution	*K. Alvin Merendino*	833
Has the Time Come to Classify Peptic Ulcers?	*James C. Thoroughman*	835
Organization of the Small Arteries of the Hand and Digits	*Edward A. Edwards*	837
Local Pedicle Flaps in Traumatic Amputations of the Finger Tip	*John J. Bowe*	847
Cartilaginous Tumors of the Jaws and Facial Regions	*Lyle V. Kragh* *David C. Dahlin* *John B. Ericb*	852

Polymorphous Cell Tumor of the Thyroid	*V. E. Chesky* *C. A. Hellwig* *J. W. Welch*	857
The Value of Cholecystography in Acute Cholecystitis (with Special Reference to Non-visualization)	*Alex E. Pearce*	866
Spontaneous Chylothorax in the Neonatal Period	*E. Thomas Boles, Jr.* *Robert J. Izant, Jr.*	870
Mesenteric Cysts. Review of the Literature with Report of an Unusual Case	*John R. Ford*	878
Cyanosis Following Cardiopulmonary Bypass	*Robert S. Cartwright* *George J. Magovern* *Edward M. Kent*	885
The Effect of Serum Albumin on Enzyme Activity in Experimental Hemorrhagic Pancreatitis in Dogs	*Arthur F. Geis* *Anthony P. Santomauro* *Ernest Meese* *Phillip Wels*	891
Postoperative Pancreatic Fistula	*Thomas C. Case*	898
Femoral Hernias in Pediatric Patients	*Robert K. Baum*	904
Portal Cirrhosis. Causes of Death in the Era of Portal Decompression	*Lt. Col. Eddy D. Palmer*	906
Carcinoma of the Thyroid: Rational Course of Therapy and Results in Seventy-five Patients	*Capt. Peter W. Hoagland* *Major Alexander M. Boysen* *Major Elbert B. Fountain* *Col. William W. Nichol* *Col. Warner F. Bowers*	908
A Curette for Embolectomy	*R. O. Heimbecker* *Gordon Murray*	918
A New Type of Intestinal Clamp	*Charles A. Schiff*	921
A New Retractor for Biliary Surgery	*Seymour W. Meyer*	924
A New Type of T Tube for Operative Cholangiography	*Richard N. Myers*	926
A Retractor for Ingrown Toenail Operations	*Leo A. Sachar*	928
Aneurysm of the Bifurcation of the Innominate Artery. Successful Excision and Restoration of the Carotid Artery	*Harold A. Zintel* *Earl R. Risbeck*	929
Left Hepatic Lobectomy and Simultaneous Portacaval Shunt for Hepatoma Associated with Cirrhosis and Portal Hypertension	*Lee B. Brown* *W. Dean Warren*	934
Obstruction of the Cecum	*George J. Wittenstein* *Robert F. Holdren*	938

Gunshot Wounds of the Abdominal Aorta	*Charles H. Manlove, Jr.*, *Frank W. Quattlebaum*, *Robert S. Flom*, *James W. LaFave*	941
Small Bowel Obstruction Due to Hemorrhage Secondary to Anticoagulant Therapy	*Allan E. Gilbert*, *Norman C. Jorgenson*	945
Recognition of a Pathognomonic Sign for the Retropharyngeal Goiter	*George Crile, Jr.*	949
Calcinosis	*H. Annamunthodo*	951
Hürthle-Cell Tumor of the Thyroid	*Mohammed H. Salem*	956
Adrenal Rest Tumor of the Liver	*Lt. Comdr. Vincent J. Hyams*, *Lt. Donald F. Thomas*, *Capt. S. S. Sarkisian*	960
Anterior Dislocation of the Shoulder	*Richard F. Slager*	964
Bronchogenic Carcinoma	*James W. Quinn*	966
Surgery Court Cases	*Howard Newcomb Morse*	968
The Diagnostic Corner	*Sidney W. Nelson*	970
Our Surgical Heritage	*D. P. Hall*	974
Author Index, Volume 99		978
Subject Index, Volume 99		981

The American Journal of Surgery

VOLUME 99 JANUARY 1960 NUMBER ONE

EDITORIALS

Cooperation versus Conflict in the Surgical Pathology Consultation

CONSULTATIONS in surgical pathology do not differ in basis from clinical consultations. The same rules of ethics and courtesy should apply. The pathologist should regard the clinician's request for consultation in the same light as the clinician would regard a similar request from the patient or his family. The atmosphere may or may not be one of cooperation, depending on the procedure and the personalities involved. To clarify this matter let us consider a few sample personalities and situations.

At one extreme, consider Surgeon Loudfellow, who basically thinks pathologists are unnecessary. He knows he can tell in advance how the surgical pathology report should read and what the diagnoses should be. He has no doubt that all his tumors are completely excised. Every appendix he removes is inflamed. At the slightest variation from these cardinal principles, he storms into the pathologist's office demanding that changes be made. Sometimes Surgeon Loudfellow deigns to look into the microscope himself, although on a scientific basis he may not be able to tell a leukocyte from a parasite. More often, he demands surgical pathology consultation on every case in which the pathologist has not corroborated his preconceived ideas. Surgeon Loudfellow thinks that all pathology consultations should be without fee, "since all you fellows just look at slides for each other anyway." He prefers consultations with Professor Odinjove of his old medical school, obviously the ultimate source of true wisdom. In this way Loudfellow feels he demonstrates his intellectual equality with Professor Odinjove and his superiority to the local pathologist.

Surgeon Loudfellow is frequently found in association with Pathologist Tepidmilk, a weak, timorous individual. Tedpidmilk is perhaps well trained but uncertain, and fearful of his position. Surgeon Loudfellow can force him into committing himself on certain frozen sections when Tepidmilk knows the material is not diagnostic. Then, when the permanent section necessitates a different diagnosis, Tepidmilk finds himself in an indefensible position, without support from Loudfellow. Pathologist Tepidmilk may change his diagnoses under pressure from Surgeon Loudfellow, even though he has doubts as to the correctness of the changes. Pathologist Tepidmilk may feed his insecurity by requesting other pathologists to confirm obvious diagnoses of normal appendices, or of invasive, inadequately excised carcinomas. Surgeon Loudfellow and Pathologist Tepidmilk have the same natural symbiotic relationship as a whip and a bleeding back.

The counterpart of Surgeon Loudfellow is Pathologist Bullhead. In his mind, each diagnosis rendered is complete, final, as if graven on stone tablets by a thunderbolt from heaven. Should the clinician's judgment differ, Bullhead will not heed remonstrations. If a surgeon requests a pathology consultation, Pathologist Bullhead is irate and wounded. He feels that his personal integrity and ability are assailed. Pathologist Bullhead considers himself fully

LIBRARY
BOSTON UNIVERSITY
SCHOOL OF MEDICINE

and equally competent in all phases of tissue diagnosis. He is unheeding of the possible merits of consultation with any other pathologist, including Professor Odinjove. He may refuse to let slides leave his laboratory for requested consultations. Pathologist Bullhead is apt to lead an unhappy life. Not only Surgeon Loudfellow but also many more reasonable clinicians will be dissatisfied with his services and attitude.

Pathologist Tepidmilk has his clinical counterpart in Surgeon Tunnelmole. During his medical school days he heard dogmatic presentations on pathology from Professor Odinjove. He still thinks surgical pathology is an exact science. Surgeon Tunnelmole will accept the pathologist's diagnoses without question, even if his clinical impression differs strongly. He never suggests that another opinion on the slides might have merit. It never occurs to him that the tissues may have become confused, that the pathologist may have had an off-day or may have limited abilities in the particular field represented by the specimen.

Any combination of these physicians may be unfortunate. Pathologist Tepidmilk will become the "stooge" of Surgeon Loudfellow, with little value or function in the scheme of things. Frequently Surgeon Loudfellow is quite capable, when the vacillations and insecurities of Pathologist Tepidmilk will do less harm. The combination of Surgeon Tunnelmole and Pathologist Tepidmilk has little force for good or evil.

Surgeon Tunnelmole and Pathologist Bullhead are not a good team for the benefit of their patients. Suppose Bullhead tends to make a certain error regularly. For a simple example, consider the microscopic differentiation of active senile keratoses and low grade squamous cell carcinoma of the skin. Suppose that Pathologist Bullhead has a certain bias for underdiagnosis of carcinoma in this context. Some of Surgeon Tunnelmole's patients will have spread and metastasis of their "keratoses." The value of early diagnosis of cancer will be lost. Eventually, the growth of these lesions will bring Pathologist Bullhead's errors to light. Corrections may ensue. Suppose that Pathologist Bullhead overdiagnoses cancer. He calls certain borderline lesions squamous cell carcinoma, when in truth they are only keratoses. Surgeon Tunnelmole is happy, with a high cure rate of "skin carcinoma." The patients are also happy, since they are heaving their "cancers" cured. However, many of them are being put to mental stress and financial burden unnecessarily. This may go on for years as long as Surgeon Tunnelmole accepts Pathologist Bullhead's diagnoses without question, and Bullhead dogmatically avoids consultations with his peers. In the words of Stewart,* "For the pathologist to err is, as usual, human. For him to err often is entirely unreasonable, and for him to err repeatedly in the same direction is an indication that he hasn't got any sense, because he hasn't even checked up on his own mistakes." Another way of expressing the same thought might be, "An intellectually isolated pathologist perpetuates his own errors."

Now let us meet our heroes, Surgeon Alert and Pathologist Sharp. Sharp is well trained and has confidence in his abilities, but knows their limitations. He is meticulous and painstaking. He keeps his diagnostic acumen at a high level and up-to-date. He frequently trades problem cases with nearby pathologists, for mutual interest and benefit. He attends slide seminars to add to his store of knowledge of surgical pathology. Pathologist Sharp does not conceal any doubts he has about his ability to handle certain individual cases or some categories of lesions. When he meets a condition outside his previous experience or his field of competence, he voluntarily seeks consultation. This may be with nearby pathologists, with his old teacher, Professor Odinjove, or with other authorities in the field involved. When a clinician requests a surgical pathology consultation, Pathologist Sharp feels no pangs of insecurity. He manifests no reluctance or emotion, even though he is absolutely certain as to the accuracy of his own diagnosis. Pathologist Sharp urges the clinician to select the consultant. This may be done in conference, but the clinician's choice should prevail. Pathologist Sharp furnishes a full set of slides, with gross findings and other pertinent information, to the consultant. He considers the consultant's report fully and benefits thereby. If Pathologist Sharp has the confidence of the physicians he serves, and he usually does, the number of consultations he

* Stewart, F. W. The importance of pathologists in the cancer program. Cancer Teaching Day, New York State Department of Health, Division of Cancer Control, 3: 55–66, 1943.

seeks voluntarily will far exceed the number requested by clinicians. "The proper pathologist seldom needs to be asked to seek consultation because he knows himself when he needs it."*

Surgeon Alert is well trained clinically and has a background of knowledge of surgical pathology. He maintains this by attending teaching conferences and by reviewing slides from his own interesting cases with the pathologist. He does not request consultations merely because his clinical impressions are not confirmed. However, he carefully evaluates each surgical pathology report in relation to the clinical setting. If he feels any doubt as to the validity of the pathologist's report, a friendly conference results. If Surgeon Alert is not fully satisfied with the outcome of this conference, or if he has any reason to doubt the pathologist's competence in the special field involved, he requests consultation. He does not hesitate to request consultation whenever he feels it is indicated, even in the face of reluctance by the local pathologist. The welfare of Surgeon Alert's patient amply justifies any abrasions of the pathologist's ego. Surgeon Alert understands that the consultant may expect a fee. He makes sure that the consultant has known competence in the type of lesion under discussion and that his opinion will be generally respected. Should the consultant's opinion differ from that of the local pathologist, Surgeon Alert will weigh all factors carefully. He understands that many phases of surgical pathology are well defined, but that others are under current study and clarification. In these areas, opinions of competent pathologists may differ without reflection on the basic ability of either.

Surgeon Alert and Pathologist Sharp understand the surgical pathology consultation as an opportunity for cooperation. They can work together in mutual confidence and respect, to the patient's benefit.

ALVAN G. FORAKER, M.D.,
Jacksonville, Florida

* STEWART, F. W. Ibid.

Elective Surgery for Duodenal Ulcer—A Graded Approach

SURGEONS are well aware that there is no single perfect operation for chronic duodenal ulcer, for if there were one, its superiority would be acclaimed without hesitation. As it is today, operations for chronic duodenal ulcer may be classed in one of three groups: (1) subtotal gastric resection; (2) vagotomy with a drainage procedure, such as gastroenterostomy or pyloroplasty; (3) vagotomy with a small gastric resection (removal of 50 per cent or less of the stomach). Any of these operations may be followed by the catastrophe of death. That the death rate may be generally higher than we would like to believe it to be, is suggested by the results of a recent survey* conducted by the Ohio Chapter of the American College of Surgeons and published in this Journal.

In the composite figures taken from a number of leading hospitals the mortality is 4.3 per cent for a total of 2,562 elective operations performed by 432 surgeons. It is significant that the mortality is 4.9 per cent for those operations associated with gastric resection (about 80 per cent of all the operations), whereas it is only 1.7 per cent for all lesser procedures. I believe both rates to be too high for elective operations. As surgeons, we should be dissatisfied with a mortality rate far exceeding that generally reported for hysterectomy or cholecystectomy. Since elective gastric resection for duodenal ulcer usually is reported as accompanied by a mortality rate greater than 2 per cent, even by surgeons with a large experience, perhaps the intrinsic risk of the operation is too great to justify its routine application to a benign condition.

There must be valid reasons why a clearly safer procedure such as vagotomy and gastroenterostomy is not more widely used. The reason is to be found in the higher recurrence rate of a duodenal or stomal ulcer after these lesser procedures. This recurrence rate has been reported to be as high as 8 per cent, in comparison with ulcer recurrence rates of less than 1 per cent after vagotomy with limited gastric resection.

Has not too much attention been paid to recurrent ulceration as a cause of failure, and too little attention to fatality rate and, in particular, to the loss of weight and malnutrition which may follow gastric resection? In about half the patients who experience a recurrent ulcer after vagotomy with a bypass or a drainage operation the ulcer is well controlled with simple medications and dietary precautions—not to be confused with an ultrastrict medical regimen—and the patients regard themselves as adequately benefited by their operations. The remainder can, if necessary, undergo a secondary gastric resection, which will give them all the benefits, insofar as avoidance of recurrent ulcer is concerned, they would have experienced if gastric resection had been performed in the first place. In my experience, approximately 5 per cent of patients who have had vagotomy with gastroenterostomy will require a secondary gastric resection within five to ten years. It is a noteworthy clinical observation that these secondary operations are just as safe as primary resections and indeed may actually be safer, since the duodenal ulcer usually is quiescent and the inflammation in this area, which increases the risk, has disappeared.

There is an additional technical reason why surgeons have not adopted in greater measure vagotomy with a drainage procedure. As a corollary of overemphasis on recurrent ulceration as a cause of failure, and of underemphasis on death rates and nutritional crippling, many able surgeons have not bothered to master the technical details of the performance of a good

* Survey Committee (S. O. Hoerr, Chairman), Ohio Chapter, American College of Surgeons. Elective operations performed for duodenal ulcer, with their mortality; results of a survey in selected Ohio hospitals. *Am. J. Surg.*, 96: 365–368, 1958.

subdiaphragmatic vagotomy. In comparison with the proficiency they show with gastric resection, they perform their occasional vagotomy with difficulty, and sometimes inadequately. Every surgeon who has had a large experience with vagotomy and a drainage procedure has called attention to the necessity of the search for and division of small vagus fibers that are so frequently present and that may prevent a good result if left undivided.

Perhaps knowledge yet to be acquired will guide us to the selection of the best operation for the particular patient with better effect than is now possible. Until that time, perhaps the surgeon should view with greater satisfaction the 80 to 85 per cent of benefited patients after vagotomy and gastroenterostomy, and note the relative absence of fatalities and postoperative nutritional woes. Perhaps the surgeon should perfect his technic of subdiaphragmatic vagotomy, and learn the wide, one-layer, Heineke-Mikulicz pyloroplasty advocated by Weinberg or the careful dependent placement of a gastroenterostomy—details that are functionally essential to proper gastric emptying and an effective operation. Perhaps he should constantly recall the maxim, "you can always take some stomach out, but you cannot put it back in," and should view with equanimity the secondary gastric resection that occasionally is needed.

STANLEY O. HOERR, M.D.,
Department of General Surgery,
The Cleveland Clinic Foundation; and
The Frank E. Bunts Educational Institute,
Cleveland, Ohio

An Experimental Study of Resection and Replacement of the Superior Vena Cava

W. MARSHALL EAST, M.D.* AND WILLIAM H. MULLER, JR., M.D., *Charlottesville, Virginia*

From the Department of Surgery, University of Virginia School of Medicine, Charlottesville, Virginia.

OBSTRUCTION of the superior vena cava is a rare syndrome which causes symptoms related to restriction of blood flow through this vessel. Venous pressure in the upper extremity is elevated in proportion to the degree of obstruction, and the symptoms which may appear are orthopnea, cyanosis and edema of the head and neck, prominence of the eyes, injection of the conjunctiva and dilatation of the superficial veins of the thorax, abdomen, neck and arms. In the more severe cases of occlusion, there may be pleural and pericardial effusion, pulmonary edema, edema of the head and neck, vertigo, syncope and even epileptic seizures.

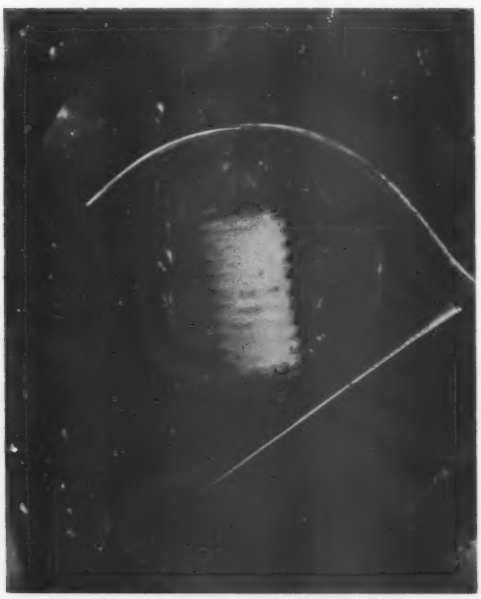


FIG. 1. Method of replacement of the superior vena cava with Edwards knitted prosthesis of teflon.

Hussey, Katz and Yater [1] reviewed the literature and reported their series of thirty-five cases in 1946. They found that the majority of the cases were secondary to primary or metastatic thoracic neoplasms. Aortic aneurysms were the second greatest cause, and among the lesser causes were mediastinitis and simple thrombosis. Treatment of superior vena caval obstruction in the past has been rather discouraging. Now, however, for most patients with thoracic neoplasm, palliation through surgery is possible and, in other instances, permanent or long term relief is a reality.

Prior to 1948 the only surgical treatment was that of mediastinal decompression [2] or lysis of constricting bands [3,4]. In 1948 Gerbode, Yee and Rundle [5] produced superior vena caval obstruction in dogs and subsequently relieved it by anastomosing the azygos vein to the vena cava, azygos vein to the right atrium, and the vena cava to the right atrium with excellent results. The first use of a free vein graft was reported by Klassen, Andrews and Curtis [6] in 1951. Since then, others [7–9] have used free, autogenous and homologous vein grafts in clinical and experimental superior venal caval replacement. Results with these vein grafts have been equivocal. Hanlon and

* Fellow in Cardiovascular Surgery, Virginia Heart Association, July 1957 through June 30, 1958.

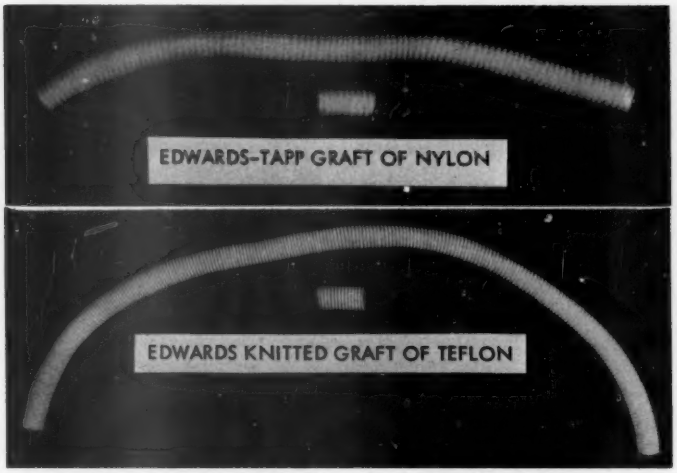


FIG. 2. Edwards-Tapp prosthesis of nylon and Edwards knitted prosthesis of teflon used in replacement of superior vena cava

associates [17], however, have used autogenous vein grafts successfully. Similar experience has been encountered with the use of aortic homografts [9,13]. Deterling and Bhonslay [9] in 1955 reported discouraging results with prostheses of Ivalon® sponge, Dacron or nylon taffeta and woven nylon tubing. Enerson and Galante [14] in 1957 reported successful replacement of the superior vena cava experimentally with homologous aortic segments externally supported with Edwards-Tapp nylon tubing; however, the animals were followed up only from one to five weeks. These investigators also bypassed the cava by inserting nylon tubing side-to-end into the cephalad superior cava and end-to-side into the base of the right atrium or intrapericardial cava. All of these thrombosed; however, in one animal nylon tubing anastomosed end-to-end to replace a portion of the superior vena cava remained patent. In 1957 Riberi and Moore [15] reported successful replacement of the superior vena cava with a pedicle tube created from the right atrium and appendage.

As the review of the literature indicates, the problem of replacement of large veins has not been solved to the complete satisfaction of the surgeon. The most ideal replacement of the superior vena cava would seem to be an autogenous vein graft, but large autogenous veins are difficult to obtain. The purpose of this paper is to present an experimental study of methods for replacing the vena cava with prostheses, and to report the results of this treatment in a series of normal dogs and those with experimentally occluded superior venae cavae.

METHOD

The experiments were performed on adult mongrel dogs weighing 8 to 20 kg. Prefabricated Edwards-Tapp crimped tubes of chemically treated nylon* measuring approximately 2.0 cm. in length with an inside diameter of 1.25 cm. were implanted in seven of the larger dogs. Two of these animals had undergone partial occlusion of the superior vena cava, and the azygos vein had been transected four months and three months, respectively, prior to replacement of the superior vena cava with the nylon prosthesis.

Prefabricated Edwards knitted crimped tubes of teflon* measuring approximately 2.0 cm. in length with an inside diameter of 9.6 mm. were implanted in seven of the smaller dogs. One of these animals had undergone partial ligation of the superior vena cava and transection of the azygos vein fourteen weeks prior to insertion of the prosthesis.

The method of implantation was as follows: Intravenous anesthesia of veterinary Nembutal® was administered (5 gr. or 1 cc. per pound of body weight). An endotracheal tube

* Supplied through the courtesy of United States Catheter and Instrument Corporation, Glens Falls, New York.

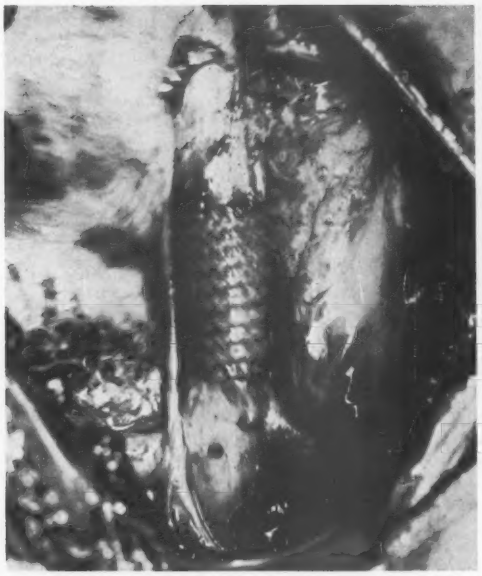


FIG. 3. Functioning Edwards-Tapp prosthesis of nylon shortly after replacement of superior vena cava.

FIG. 4. Angiogram with Hypaque® of superior vena cava (dog 441) four months after prosthetic replacement showing free flow of dye through the prosthesis into the auricle.

and mechanical respirator were used. A right posterolateral thoracotomy in the third intercostal space provided excellent exposure. The superior vena cava was dissected completely from its tributaries to its entry into the right auricle. The pericardium was incised for 1 to 2 cm., and the pericardial reflection was dissected from the caval wall. The azygos vein was doubly ligated and transected so that more accurate changes would be reflected in the pressures of the jugular and cephalic veins postoperatively if the graft became occluded. A Potts patent ductus clamp was placed across the superior vena cava at its entry into the auricle. (Fig. 1.) A segment of the superior vena

TABLE 1

REPLACEMENT OF SUPERIOR VENA CAVA WITH NYLON AND TEFLON VASCULAR PROSTHESES

Dog No.	Prosthesis	Superior Vena Cava Operatively Occluded	Prosthesis Implanted (No. of wk.)	Clinically Patent	Heparin Used	Condition of Prosthesis at Autopsy
596	Nylon	No	1	Yes	No	Partially occluded by thrombus
467	Nylon	Yes	4	Yes	No	Partially occluded by thrombus
433	Nylon	Yes	20	Yes	No	Slight narrowing but patent
188	Nylon	No	5	Yes	No	Slight narrowing but patent
544	Nylon	No	24 hr.	No	Yes	Completely occluded by thrombus
543	Nylon	No	8	Yes	Yes	Slight narrowing but patent
441	Nylon	No	34	Yes	Yes	Narrowed but patent
478	Teflon	Yes	16	Yes	No	Patent
587	Teflon	No	2	Yes	No	Patent
583	Teflon	No	3	Yes	Yes	Patent
577	Teflon	No	3	Yes	Yes	Patent
569	Teflon	No	5	Yes	Yes	Patent
568	Teflon	No	24 hr.	No	No	Completely occluded by thrombus
529	Teflon	No	24	Yes	No	Patent

cava, approximately 2.0 cm. in length, was resected from the pericardial reflection to just below the bifurcation. A teflon or nylon prosthesis (Fig. 2) was positioned and anastomosed to both ends of the vena cava with a continuous over and over suture of No. 5–0 arterial silk. The distal clamp was removed to allow the graft to fill with blood, thus extruding the air. The proximal clamp was then removed. There was little or no bleeding through the teflon grafts and very little through the nylon grafts. All bleeding ceased within one to two minutes after removing the clamps. (Fig 3.) Ten milligrams of heparin were injected into the prosthesis after the anastomosis in three animals in each group. (Table 1.) The ribs were reapproximated, and the chest was closed in layers with continuous chromic catgut sutures. The skin was closed with continuous No. 4–0 black silk.

Anticoagulants were not used postoperatively. No antibiotics were instilled into the chest but 300,000 units of penicillin were administered parenterally for two days postoperatively. Venous pressures in the right cephalic vein and the right external jugular vein were recorded daily on each dog preoperatively for the first three days and then at weekly intervals. The dogs were sacrificed from one to thirty-four weeks later. Patency of the prostheses was determined by venous pressures, cavagrams (Fig. 4) and necropsy.

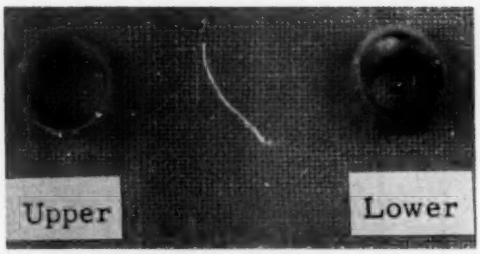


FIG. 5. Gross appearance of cross sections of nylon prosthesis (dog 596) one week after insertion. Formation of thrombus is greater at lower anastomosis.

RESULTS

Table 1 summarizes the autopsy findings. Of seven dogs in which crimped nylon tubes were used to replace the superior vena cava, there was one complete failure (No. 544). In two others (Nos. 467 and 596) there was partial occlusion by an organized thrombus lining the wall of the graft; however, the lumen was covered with a thin pseudoendothelial layer. In dog 467 the cause for partial occlusion was undetermined. In dogs 544 and 596 the complete thrombus and partial thrombus, respectively, were probably the results of damage to the caval wall which inadvertently occurred at the time of insertion of the prostheses. (Fig. 5.) The two animals with partial occlusion showed no clinical evidence of obstruction to the

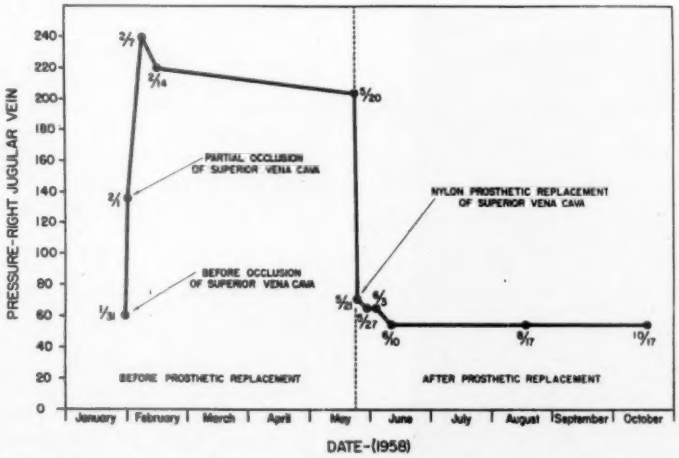


FIG. 6. Graphic illustration of venous pressures in dog 433 showing high sustained pressure after partial occlusion of superior vena cava and return to normal after prosthetic replacement of occluded segment.

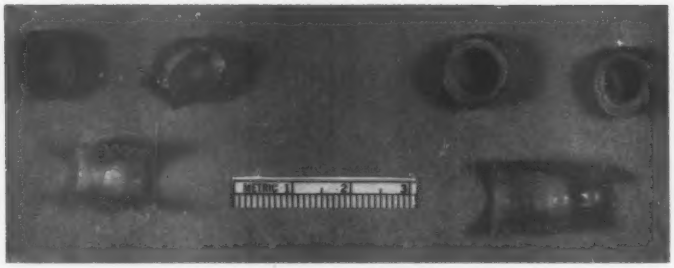


FIG. 7. Gross appearance of teflon prostheses from dogs 529 (*left*) and 478 (*right*). Dog 529 had no previous obstruction and the prosthesis was removed after six months. Dog 478 had previous superior vena caval obstruction relieved by teflon prosthesis and was sacrificed four months later.

superior vena cava, and the venous pressures remained at preoperative levels. The other four prostheses, although patent, were narrowed by a well organized layer of thrombus (1 to 2 mm. thick) which was covered by a thin pseudoendothelial layer. Venous pressures in these dogs remained at preoperative levels. The superior vena cava of dog 433 was partially occluded at operation, and four months later was replaced with a nylon prosthesis. The pressure, which rose to 240 mm. of saline immediately after partial occlusion, dropped only 35 mm. during the next four months and returned to normal levels after prosthetic replacement where it remained until the animal was sacrificed five months later. (Fig. 6.) Dog 478, which had partial superior vena caval obstruction relieved by replacement with a teflon tube, showed the same venous pressure pattern. (Fig. 7.) Dog 441 with no previous obstruction was followed up for thirty-four weeks after replacement with the nylon tube. There were no clinical signs of obstruction, and the venous pressures were normal throughout the postoperative period. However, necropsy showed narrowing due to a well organized mural thrombus with the lumen completely covered with a pseudoendothelial lining. (Fig. 8.) The fact that there was no elevation of venous pressure and no gross evidence of collateral circulation in spite of the narrowed lumen indicates that the prosthesis may have been excessively large, since one factor in producing formation of a thrombus appeared to be a disproportionate size between the prosthesis and the superior vena cava.

FIG. 8. Gross appearance of sections of nylon prosthesis (dog 441) thirty-four weeks after insertion. A thick mural thrombus is present.

All the nylon prostheses were covered externally with a relatively thick layer of fibrous tissue and surrounded with considerable inflammatory reaction. The teflon prostheses, however, were covered with a very thin fibrous tissue, and there was no significant fibroblastic reaction within the chest. (Fig. 9.) Pseudoendothelium completely lined the lumens of all the prostheses within one to two weeks.

COMMENTS

One of the prime requirements of superior vena caval prostheses is that they be semi-rigid in order to maintain patency of the lumen in the low pressures of the venous system and prevent compression or constriction from fibroblastic reaction around the prosthesis or within the lumen. Of equal consideration in choosing a venous replacement is that the prosthesis be of an inert material which is least conducive to fibrous reaction and formation of a thrombus.

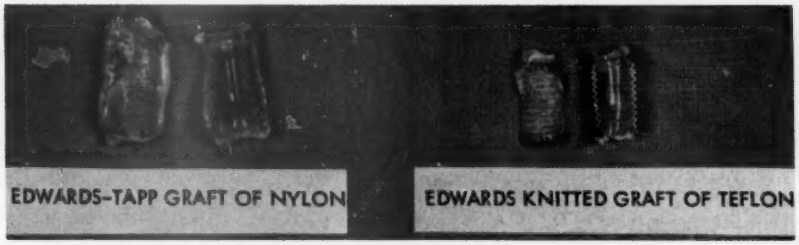


FIG. 9. Gross appearance of nylon (dog 188) and teflon (dog 569) prostheses removed after five weeks. Note the greater amount of fibrous tissue around the nylon graft, and the absence of narrowing of the lumen of the teflon prosthesis.

It is significant that twelve of the prostheses remained patent and that the two which occluded did so from thrombosis and not from collapse, compression or constriction. Even though there was considerable fibrous reaction around and within the nylon tubes, these prostheses maintained form and patency of the lumen even though narrowed by formation of a thrombus. The relative absence of fibrous tissue around the teflon tubes and the absence of formation of a thrombus within the lumen as compared to results with the nylon tubes show that the tissue response to teflon is much less. Also, teflon has a higher tensile strength, is less wettable and less permeable [*16*]. It is necessary to heat-seal the nylon tubes, but since teflon tubes are of woven material which does not ravel or fray when cut, heat-sealing is unnecessary.

One cannot emphasize too much the importance of employing meticulous technic in venous grafting. This is illustrated in these experiments by the two failures attributed to damage of the wall of the vena cava occurring at the time of implantation. That success occurred in the heparinized group and in an equal number of cases in which no anticoagulants were used at operation, plus the fact that no anticoagulants were used postoperatively, suggests that similar procedures could be performed in patients without the use of anticoagulants. The highly successful results encountered with the use of the Edwards woven prostheses of teflon in the experimental replacement of the superior vena cava indicate that such vascular replacements might be applied clinically.

SUMMARY

A review of the literature on the treatment of obstruction of the superior vena cava and its replacement is presented. Experiments were performed on fourteen dogs using nylon and teflon prostheses for replacement. Edwards-Tapp nylon prostheses were implanted in seven dogs, two of which had undergone partial occlusion of the superior vena cava. Teflon tubes were used for replacement of the superior vena cava in the remaining seven animals, one of which had undergone partial ligation of the superior vena cava and transection of the azygos vein. The teflon prostheses showed excellent results in seven dogs followed up to six months. Superior vena caval prostheses of nylon in the other seven dogs were less successful as shown by necropsy with narrowing in all the prostheses. Only one animal in this group, however, had complete occlusion by thrombus, and in the remaining six there was no clinical evidence of obstruction, and venous pressures remained normal postoperatively.

CONCLUSIONS

These studies indicate that a semi-rigid tube appears to be a major requirement in the selection of a superior venal caval prosthesis. Teflon grafts were superior to nylon because fibroblastic response and formation of a thrombus were much less. This investigation indicates that crimped teflon vascular prostheses might be suitable for clinical application for segmental replacement of the obstructed superior vena cava.

REFERENCES

1. HUSSEY, H. H., KATZ, S. and YATER, W. M. The superior vena caval syndrome: report of thirty-five cases. *Am. Heart J.*, 31: 1, 1946.
2. EHRLICH, W., BALLON, H. C. and GRAHAM, E. A. Superior vena caval obstruction with a considera-

tion of the possible relief of symptoms by mediastinal decompression. *J. Thoracic Surg.*, 3: 352, 1934.

3. Ochsner, A. and Dixon, J. L. Superior vena caval thrombosis: review of the literature and report of cases of traumatic and infectious origin. *J. Thoracic Surg.*, 5: 641, 1936.
4. Gray, H. K. and Skinner, I. C. Constrictive occlusion of the superior vena cava: report of three cases in which the patients were treated surgically. *Surg., Gynec. & Obst.*, 72: 923, 1941.
5. Gerbode, F., Yee, J. and Rundle, F. F. Experimental anastomoses of vessels to the heart: possible application to superior vena cava obstruction. *Surgery*, 25: 556, 1949.
6. Klassen, K. P., Andrews, N. C. and Curtis, G. M. Diagnosis and treatment of superior vena cava obstruction. *Arch. Surg.*, 63: 311, 1951.
7. Scannell, J. G. and Shaw, R. S. Surgical reconstruction of the superior vena cava. *J. Thoracic Surg.*, 28: 163, 1954.
8. Kay, E. B. Discussion of paper by Scannell, J. G. and Shaw, R. S. *J. Thoracic Surg.*, 28: 171, 1954.
9. Deterling, R. A. and Bhonslay, S. B. Use of vessel grafts and plastic prostheses for relief of superior vena caval obstruction. *Surgery*, 38: 1008, 1955.
10. Holman, C. W. and Steinberg, I. Treatment of superior vena caval occlusion by arterial graft. *J. Am. Med. Assoc.*, 155: 1403, 1954.
11. Higginson, J. F. Aortic homograft substitution and bypass in superior vena caval obstruction. *J. Thoracic Surg.*, 32: 684, 1956.
12. Ashburn, F. S., Sewell, W. H. and Huggins, C. E. Experimental replacement of the superior vena cava with homologous arteries and report of a case with malignant obstruction replaced with a heterologous artery. *J. Thoracic Surg.*, 31: 618, 1956.
13. Gerbode, F. Discussion of paper by Scannell, J. G. and Shaw, R. S. *J. Thoracic Surg.*, 28: 171, 1954.
14. Enerson, D. M. and Galante, N. The use of externally-supported aortic homografts in the superior vena cava. *S. Forum*, 8: 450, 1957.
15. Riberi, A. and Moore, T. C. Superior vena caval replacement. II. Successful use of a pedicle tube created from right atrium and appendage. *Surgery*, 43: 355, 1958.
16. Merendino, K. A., Girvin, G. W. and Thomas, G. I. The clinical use of Teflon tubes as a vascular substitute for major arteries. *Surgery*, 43: 959, 1958.
17. Hanlon, C. Presented at Cineclinics. Forty-third Clinical Congress of the American College of Surgeons. Atlantic City, 1957.

Insertion, with a Guide, of Multiple Nails in Fractures of the Femoral Neck

MICHAEL T. MODNY, M.D. AND HAROLD G. KUNZ, M.D., *Montclair, New Jersey*

From the Nicola Orthopaedic Group and the Orthopaedic Service of The Mountainside Hospital, Montclair, New Jersey.

THE eventual results in fractures of the neck of the femur depend upon three major considerations: (1) the viability of the head fragment; (2) accurate reduction, or mechanically advantageous reduction; and (3) rigid, uninterrupted fixation.

The multiplicity of fixative devices attests to the ramifications of the problems of rigid, uninterrupted internal fixation. Study of the various technics of internal fixation in use led us to the evolution of a method which has produced gratifying results in handling intracapsular fractures. In 100 patients treated over a period of five and a half years, we have employed a modification of the Austin Moore method of parallel multiple nail fixation [5–7].

One of us (M. T. M.) devised a simple guide for the rapid and accurate placement of the nails [3,4]. Prior to the use of the guide, introduction of the nails presented great difficulties. The nails were thin enough (7/64 inch) to be slightly flexible and the peripheral cortical bone of the femoral neck was tough enough to induce considerable deviation from the ideal path of insertion.

With the guide, four stainless steel nails (5½ inches by ⅛ inch) are easily and accurately spaced in the peripheral cortex of the femoral neck. This spacing should be as wide as possible and still remain within the limit of the femoral neck. (Fig. 1, top.) If the nails are closely spaced the mechanical advantage is lost, and the mechanical result is similar to that of a single nail. Usually the two inferior nails are imbedded in the solid calcar. Multiple nails, so placed, and lying parallel to the axis of the femoral neck and parallel to the resultant of the forces about the hip joint, allow continuous compression during absorption and healing, while preventing shearing, torsion and rotation.

Neutralization of shearing and torsional forces can be seen in structural engineering in which widely spaced rods are used to reinforce concrete columns. Parallel hip nails allow motion to occur only in the direction of compression between the fragments as absorption takes place at the fracture site. (Fig. 2.) This compressive force is purely physiological if the reduction is accurate. Rigid immobilization of the fragments depends directly upon the amount of compression between the two fragments. The sharp, smooth nails do not interpose resistant bulk to the compressive force. Rather, their parallelism allows the head to move only in the direction of compression. The wide spacing of small nails achieves maximum rigidity with a minimum of metal. Revascularization through the medullary channels and formation of necessary internal callus are not impaired by the presence of large metallic masses in the small femoral neck.

In contrast, single nails are designed for insertion in the central axis of the neck of the femur. Actually, single nails are intramedullary nails. They depend upon the soft, cancellous medullary bone for fixation and rigidity. (Fig. 1, bottom.) The cancellous bony structure does not provide firm purchase, so that shearing, torsion and rotation often result.

METHOD OF NAILING

After reduction has been accomplished, the leg is placed in the traction stirrup in internal rotation and adduction. Position of the fragments is carefully checked by x-ray films in two planes. The lateral cortex is exposed for a distance of 2 inches distal to the palpable prominence of the trochanter. It is usually marked 1 inch distal from the tip of the trochanter and

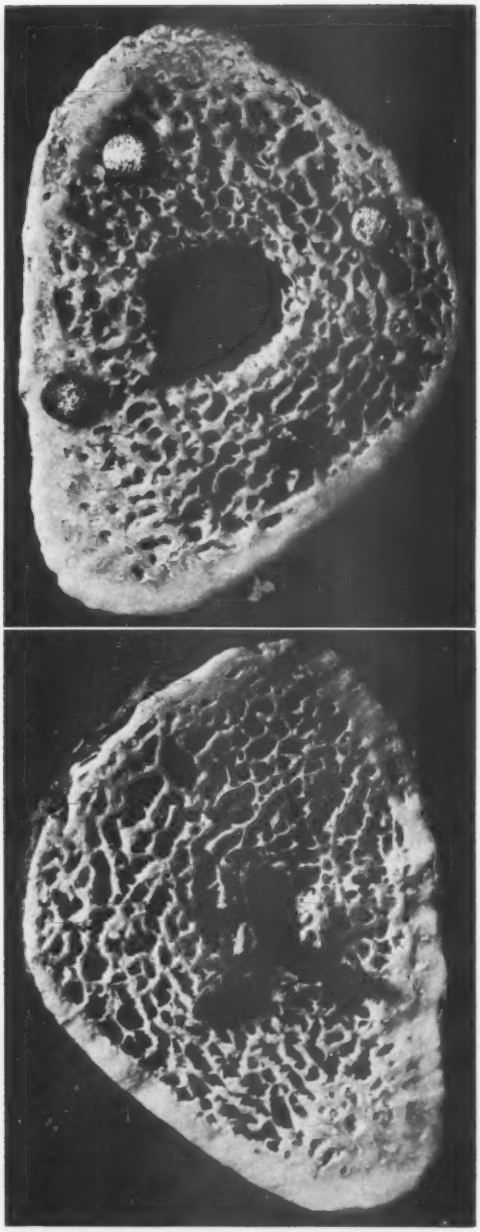


FIG. 1. *Top*, cross section of femoral neck with four peripherally placed nails. *Bottom*, cross section of femoral neck with single tri-finned nail.

a ¼ inch hole is drilled through the cortex only. (Fig. 3A.) The drill is directed parallel with the horizontal plane of the table and at an angle determined from preoperative, true, anteroposterior films of the uninjured hip. This angle directs the drill in the line of the neutral axis and aims it at the center of the head.

The guide is attached to a Smith-Petersen nail driver and the guide tip is inserted into the pilot hole in the cortex. (Fig. 3B.) The blunted tip of the guide is then gently pushed up the relatively empty and usually osteoporotic femoral neck into the head at the same angle used for the drill. Lateral positioning of the guide, which should be parallel to the floor, is determined by palpation of the direction of the anterior femoral neck. Insertion is continued until the firm resistance of the denser head is felt. A guide wire through a cannulated guide may be used, as in the insertion of the Smith-Petersen nail, but this adds another step and we have not found it necessary.

Position of the guide is now checked with anteroposterior and lateral x-rays and the direction corrected if necessary. (Figs. 3C and D.) The guide should be centrally placed in the femoral neck in both views. If the angle has been carefully predetermined and the limb is held in full internal rotation during insertion, change of direction is seldom necessary. The tip of the guide should penetrate the head fragment to the depth desired for insertion of the nails.

The guide is now rotated to position the appropriate set of holes in the collar of the guide. Two sets of holes are provided to allow for variations in the diameter of the femoral neck. The set spaced 1 inch apart is more commonly used in males. The closer spaced set is generally used in females.

The nails are mounted in a threaded ⅛ inch drill chuck. A Jacob's chuck may be used but it mars the nail threads and may prevent later application of the nuts. The nails are drilled gently into the bone through the holes in the collar of the guide to full depth. (Fig. 3E.)

The angle of insertion of the two anterior nails into the oblique cortex is quite acute. The older nails were blunt and tended to skid. We now use specially sharpened, trochar-pointed nails to obviate this difficulty. Experience has shown us that the ⅛ inch nails are to be preferred over the older 7/64 inch nails for the added rigidity and ease of insertion which they provide.

When 5½ inch nails are inserted through the

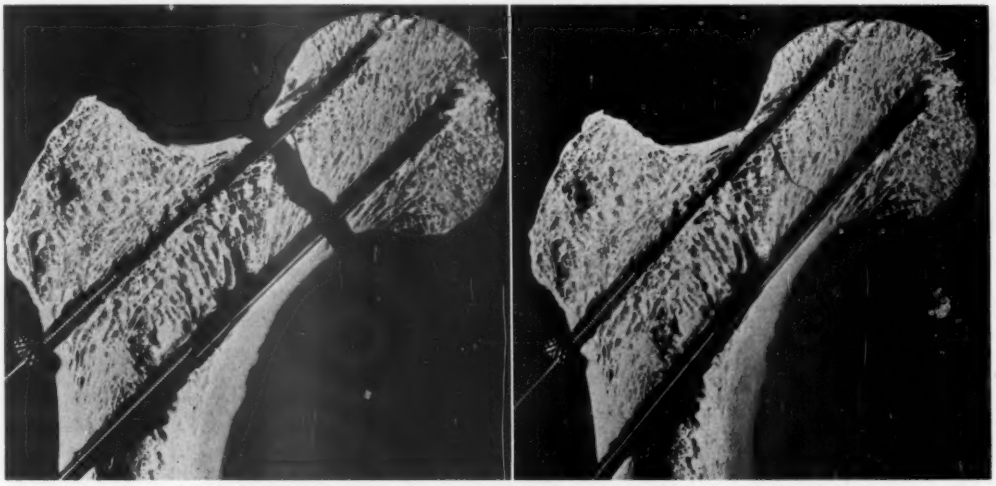
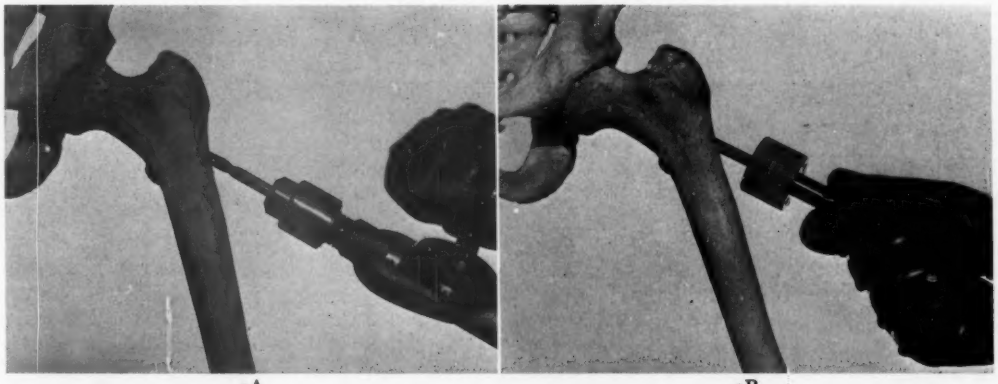


FIG. 2. Parallel hip nails allow motion to occur only in the direction of compression.

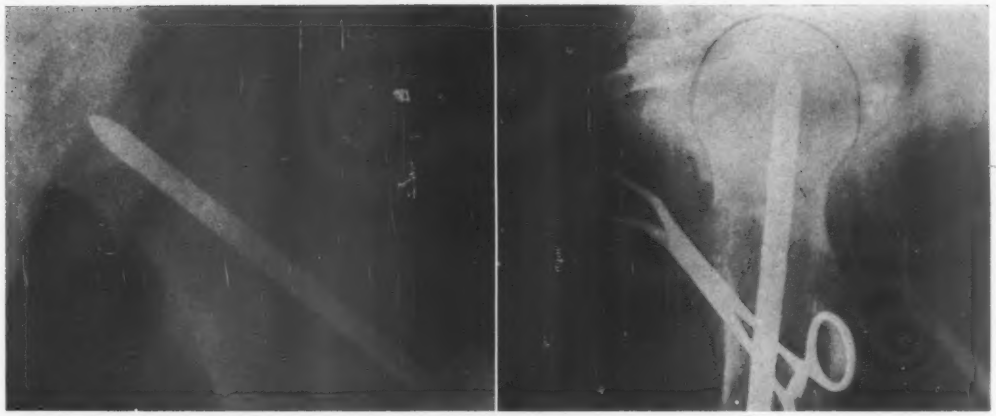
guide holes to their full depth, the tip of the nails will be at the same depth as the tip of the guide. In undisplaced fractures it is possible to insert the guide to the fracture line, and final depth adjustments of the nails can be made by checking x-ray films.

The guide prevents deviation of the nails and assures the parallel position of all four. The guide is now removed with a Smith-Petersen driver-extractor (Figs. 3F and G), and the position of the nails is checked with a third set of anteroposterior and lateral x-ray films. Fine adjustments in nail depths are readily made. The tips of the nails should be no closer than ¼ inch to the articular margin of the femoral head in both planes. This allows for settling of the head without penetration of the nails into the joint. Hexagonal nuts are now applied to the nails with a socket wrench and the excess nails portions cut off with a pin cutter. (Fig. 3H.) Crimping by the cutter prevents the nuts from backing off. At this point, traction is released. With a blunt instrument held against the lateral shaft, parallel to the nails, a few gentle taps are delivered to impact the fragments. Wound closure is routine.



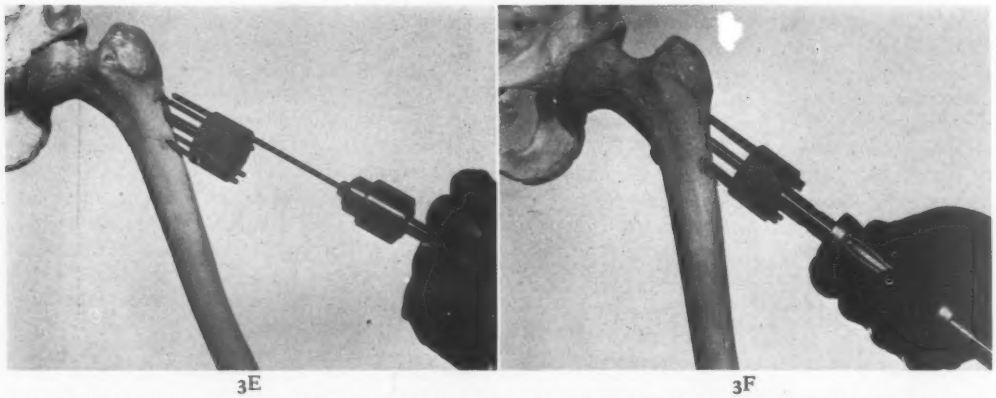
3A 3B

FIGS. 3A and B. A, lateral cortex *only* drilled 1 inch distal from tip of trochanter (¼ inch drill used). B, guide inserted in neutral axis and head.



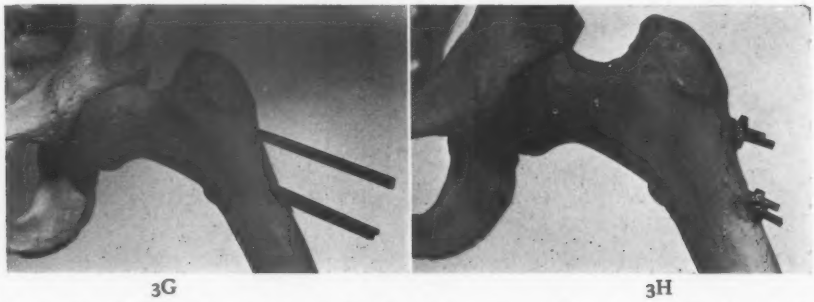
3C 3D

FIGS. 3C and D. C, anteroposterior film showing central position of guide. D, lateral view. Central placement of guide also necessary in this plane.



3E 3F

FIGS. 3E and F. E, nails inserted through guide holes. F, guide extracted with Smith-Petersen driver-extractor.



3G 3H

FIGS. 3G and H. G, nails ready for application of nuts. H, excess portion of nails sheared off.

COMMENTS

A viable head, accurately reduced with rigid, uninterrupted internal fixation, invariably gives a healed, painless hip.

Clinically, it is impossible to determine the viability of the head fragment at the time of fracture. There can be partial viability, just as there can be partial necrosis. Obviously, immediate or early reduction and fixation of the fragments is important. This eliminates further disruption of any existing blood supply, either retinacular or foveal or both. Delaying with traction allows limited but continuous motion which may contribute further trauma to the already embarrassed vascular status of the head fragment.

It is only after four to six months that variation in the degree of viability of the head fragments can first be observed on x-ray films. If fixation is rigid, with microscopic motion decreased or eliminated, then union consistently takes place, and reconstitution of necrotic areas in many cases occurs through the zone of invasion at the fracture site.

Accurate reduction allows the greatest surface area for union to occur. However, accurate reduction at times is not possible. In a grade III Pauwel fracture, in which the shearing force is so great, it is easier to position the head in a valgus manner. This procedure enhances the natural compressive forces present in the neutral axis of the femoral neck. The advantages of this type of reduction and methods of achieving it have been extensively reported [*2*].

The lower limb is a long, weighty and mobile lever arm. In intracapsular fractures of the femoral neck, the disproportion between the small head fragment and the entire lower extremity presents a great mechanical problem in achieving and maintaining completely rigid fixation. The configuration of four parallel nails, widely spaced, provides maximum structural rigidity with a minimum amount of metal. The peripheral position of the four nails enhances the probability that the two lower nails will be embedded in the dense calcar. Should the nails surface slightly at the narrow portion of the neck, it is further assurance of rigidity of fixation by firm purchase in dense cortical bone.

With four parallel nails, marked reduction of torsion results. This is due primarily to the enhanced compression present in this method of fixation, where the smooth nails utilize the resultant of the physiologic forces about the hip. Metal is a bone suture. Its primary office is not to carry weight. Metal is employed to hold the bone until it heals. The use of massive, elaborate metallic devices is in many instances unphysiologic.

In some single-nail fixations, when inadequate rigidity and insufficient compression exist, constant microscopic motion of the fragments progressively loosens the fixative device. Motion increases and massive absorption takes place. Shortening of the neck inevitably results.

The method described in this paper has been employed in 100 cases. Results in sixty-eight patients, those followed up from one to five and a half years, are presented in Table 1.

Union occurred in sixty-seven patients; in four, it was delayed. There was one case of nonunion. Avascular necrosis developed in seven patients. Extrusion of single nails occurred in five patients; of two nails in five; and of four nails in five. No breakage of nails occurred. The average age of patients was sixty-two years. The oldest was ninety-five years old and the youngest thirty-one years old. No instance of varus displacement of the head fragment occurred. There were no deaths from operation.

RESULTS

In this series, since the life expectancy of a group of patients of average age of sixty-two years (range thirty-one to ninety-five) would be low, we have been fortunate in having follow-ups of one year to five and a half years in sixty-eight cases.

In all but one patient in this series the fracture went on to union. These 100 cases were unselected.

Four patients presented delayed union; some were due to imperfect reduction and inexperience with a new operative technic.

Union adequate for full weight-bearing is difficult to determine roentgenographically in all cases. Obliteration of the fracture line occurs rapidly since the nails allow continuous compression of the fragments in the axis of the resulting forces about the hip joint.

If the relative density changes on follow-up x-ray films are massive and extend to the fracture line (even if the head is still in its pinned position), we do not believe there is union. There has been a failure of any reconstitution. If the fracture line disappears and the invasion zone extends well into the head fragment,

FIG. 4. Case 6. A, grade III Pauwel's fracture. B, anteroposterior view showing reduction and pinning. C, lateral view. D, union at nine months.

TABLE 1

Case No.	Sex and Age (yr.)	Date of Operation	Comments
1	M, 71	6/29/53	Union; hemiplegia on fracture side; patient uncooperative, bore weight 1 mo. postoperatively; no avascular necrosis
2	F, 75	7/10/53	Union; hemiplegia on fracture side; head subluxating 3 mo. postoperatively
3	F, 91	11/19/53	Union; patient walked unassisted at 5 mo.; painless hip; no avascular necrosis at death 2 yr. later.
4	M, 77	3/16/54	Union; open reduction of fracture; full weight-bearing after first week due to disorientation; painless hip with no avascular necrosis at death 5½ yr. later
5	F, 68	7/27/54	Union; lost to follow-up at end of 2½ yr.; no avascular necrosis and painless hip at that time
6 (Fig. 4)	M, 45	7/29/54	Union; grade III Pauwel's fracture; reduction poor, fixation adequate; no avascular necrosis
7	F, 51	8/5/54	Union; valgus impacted fracture; minimal arthritic changes at end of 3 yr.; no increased density of head
8	M, 73	8/13/54	Union; no disability
9	F, 65	11/4/54	Union; no disability; one nail extruded
10	F, 60	3/1/55	Union; no disability
11 (Fig. 5)	F, 73	3/10/55 11/19/55	No guide used at first operation; improperly placed, crossed, 7/64 inch pins extruded and broke; 11/19/55: repinning done with guide and fibula graft inserted in guide hole; solid union followed; painless hip at present
12	F, 63	4/16/55	Union; improper technic: pins placed too close to articular surface, penetrated joint; at end of 6 mo. three pins extruded distally; avascular necrosis
13	M, 72	6/1/55	Union; improper technic used: two nails penetrated medially and extruded; repinning done 4 mo. later; 7/2/57: two pins extruded and were removed; painless hip; no avascular necrosis at this time
14	F, 65	6/14/55	Union; painless hip
15	F, 46	7/5/55	Union; valgus impacted fracture; major portion of head viable; small areas of dense, avascular bone present; all pins removed; avascular necrosis noted
16	M, 63	7/19/55	Union; no avascular necrosis
17	M, 68	8/20/55	Union; no pain; excellent function
18	M, 82	10/12/55	Union; patient disoriented, weight-bearing from first day postoperatively; improper technic used: nails too close to articular surface, neck impacted forcing three nails through articular surface; healed in good position; three nails removed at end of 1 yr., lateral extrusion; avascular necrosis developing; patient died at end of 2 yr.
19	F, 81	10/19/55	Union; patient lost to follow-up at end of 2 yr.
20	F, 72	10/21/55	Union; poor technic used: one nail extruded through articular surface; avascular necrosis 7/1956
21	F, 77	12/8/55	Union; no complications
22	F, 50	12/12/55	Union; no avascular necrosis
23	F, 81	12/24/55	Union; patient lost to follow-up after 2 yr.
24	F, 81	12/30/55	Union; patient lost to follow-up after 18 mo.
25	F, 77	1/3/56	Union; no avascular necrosis
26	F, 57	1/15/56	High subcapital fracture; patient returned to full-time duty in mental hospital in 9 mo.; avascular necrosis developed at 18 mo.
27	F, 82	2/9/56	Union; patient died 1 yr. later
28	F, 62	2/24/56	Union; avascular necrosis present and Moore prosthesis inserted 1 yr. later
29	F, 77	3/12/56	Union; no avascular necrosis to date
30	F, 95	3/27/56	Union; no avascular necrosis
31	F, 71	4/20/56	Union; no avascular necrosis; nails removed
32	F, 74	6/1/56	Union; no avascular necrosis
33	F, 51	6/3/56	Union; no avascular necrosis
34	F, 65	8/18/56	Union; no avascular necrosis
35	F, 78	8/23/56	Union; all pins removed; no avascular necrosis to date
36	F, 86	8/30/56	Union; no avascular necrosis
37	F, 64	9/14/56	Union; no avascular necrosis
38	M, 75	10/3/56	Union; no avascular necrosis
39	F, 90	10/12/56	Union; no avascular necrosis
40	F, 74	10/14/56	Union; painless hip
41	F, 75	10/24/56	Union; no avascular necrosis to date
42	F, 61	11/2/56	Union; no avascular necrosis
43	F, 49	11/9/56	Union; no avascular necrosis to date; two nails removed
44	M, 79	11/21/56	Union; severe parkinsonism; pinning done with six nails; one nail extruded at 2 yr.; no avascular necrosis; hip completely asymptomatic and functional

TABLE 1 (*Continued*)

Case No.	Sex and Age (yr.)	Date of Operation	Comments
45	F, 82	11/27/56	Union; four pins removed 1 yr. later; avascular necrosis with deformity of the head at this time
46	F, 72	1/7/57	Delayed union; two nails removed
47	F, 62	1/21/57	Union; no density changes
48	F, 60	1/23/57	Union; no avascular necrosis
49	M, 68	2/1/57	Union; no avascular necrosis; nail removed
50	F, 70	2/4/57	Union; painless hip; no avascular necrosis
51	F, 54	2/12/57	Union; no avascular necrosis
52	M, 31	2/23/57	Union; painless hip; no avascular necrosis
53	M, 72	4/1/57	Union; no avascular necrosis
54	F, 59	4/5/57 7/18/57	Non-union; nails penetrated at end of 3 mo., were removed and bone graft inserted; avascular necrosis and severe degeneration of head fragment occurred
55	F, 63	4/20/57	Union; painless hip; no avascular necrosis
56	F, 78	4/23/57	Union; painless hip; two nails extruded
57	F, 69	5/20/57	Delayed union, but united later
58	F, 75	5/21/57	Union; painless hip; no avascular necrosis
59	F, 83	6/2/57	Union; patient lost to follow-up after 14 mo.
60	F, 82	6/12/57	Union; no avascular necrosis; four nails removed
61	M, 62	8/14/57	Union delayed for 1 yr., poor reduction; at present fracture is united and patient is well with no avascular necrosis
62	M, 48	8/22/57	Union; no avascular necrosis
63	F, 62	9/27/57	Union; no avascular necrosis
64	F, 72	10/14/57	Union; asymptomatic hip; two nails extruded; no degenerative changes
65	M, 64	10/29/57	Union; no avascular necrosis
66	F, 86	11/2/57	Union; no avascular necrosis
67	M, 61	11/5/57	Delayed union; no degenerative changes; lateral migration of one nail which was removed
68	F, 85	11/26/57	Union; asymptomatic hip; no avascular necrosis

we consider there is union. However, whether there will be further deposition of living bone on avascular bone is an individual problem. Coleman, Compere and Tachdijian [1] have stated: "Dead bone requires replacement for proper function of a part. The bone must be absorbed and new bone deposited in its place. To some degree this occurs in all femoral heads following fracture: and the completeness with which the new bone is replaced governs in large measure the future integrity of the head."

One important index of union is the absence of pain. We delay full weight-bearing for at least six months, and we emphasize to patients the importance of this regimen. In our four patients with delayed union, weight-bearing was postponed up to eighteen months.

In our younger patients, in whom union had occurred, we also postponed full weight-bearing for an additional period. It will be recognized that it is possible to reason with younger patients for their own good, whereas the older patient forgets and does what he or she wants. There were cases of unauthorized weight-bearing because the patient was comfortable and his or her enthusiasm outweighed more cautious advice.

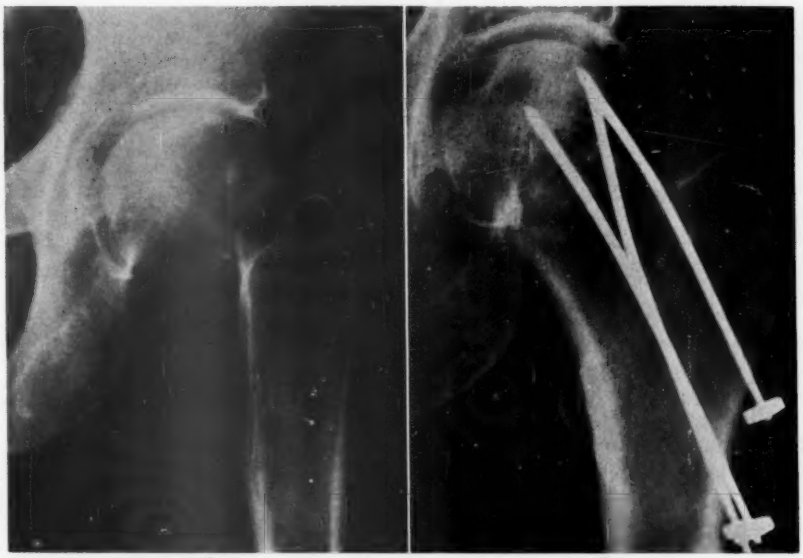
Extrusion. Lateral migration of the nails may occur, usually when the hip is healed. Constant movement of the vastus lateralis may slowly loosen the nail in the lateral cortex. The nut and nail imbedded in the fibers may gradually migrate.

Austin Moore reported on the use of stainless steel wires wound around the protruding portion of the nails in the lateral cortex, with very few extrusions.

Lateral migration may also occur from placing the nails too close to the articular surface. In this event the settling of the head fragment may cause penetration of the hip joint, and the constant motion will cause extrusion.

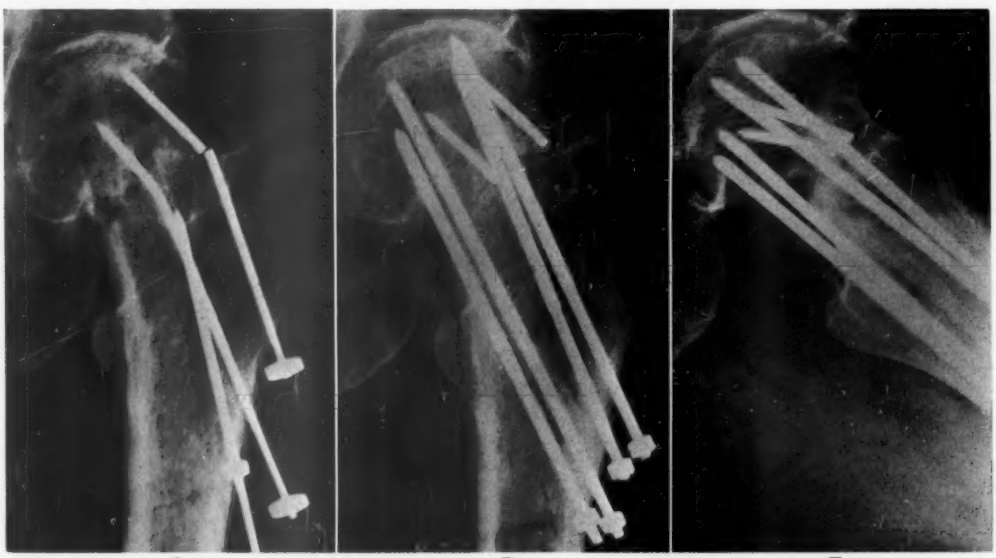
Extrusion occurs late in the postoperative period and usually involves a single nail. This may be removed in a simple office procedure with a stab wound over the protruding nail under the skin. Loss of one nail, or even two nails, leaves two or three nails still imbedded and union was unaffected in the cases in which this occurred. We have had five patients in whom it was necessary to remove all four nails because of lateral extrusion. In four, the fracture was united at the time of removal. In the fifth patient the nails were extruded during the third postoperative month and there was non-union of the fracture. A bone graft was inserted and non-union is still present.

In all our patients there was no further varus



5A 5B

FIGS. 5A and B. Case 11. A, displaced varus fracture in seventy-three year old woman. B, reduction. Inadequate fixation with three poorly placed nails without use of guide.



5C 5D 5E

FIGS. 5C to E. C, non-union. Fracture of old-type 7/64 inch nails. D, anteroposterior view of repinning with guide, using four well spaced parallel nails. E, lateral view of repinning.

displacement of the head fragments. Any displacement occurred in a valgus manner. Greater density of the medial portion of the femoral neck inclines the head in a valgus manner to the thinner lateral aspect as compression and absorption take place.

Avascular Necrosis. In this series, considering early avascular necrosis and its later manifestation of arthritic changes, avascular necrosis occurred in seven patients: at six months in one, at nine months in one, at twelve months in three, at eighteen months in one, and at two and a half years in one.

We recognize that with a one- to five and a half-year follow-up we cannot include what may be eventual avascular necrosis. However, in our hands, the incidence of density changes has been gratifyingly small.

In this operative series there were two impacted valgus fractures. It is interesting that union was rapid in both but there were late, mild arthritic changes due to localized trauma to cartilage and subchondral bone. However, there were no density changes of the major portion of the head fragments.

SUMMARY

1. A four-nail fixation of fractures of the femoral neck, introduced by Moore, offers optimum rigidity with the least amount of metallic substance. Difficulty of proper insertion and positioning of the nails led to the development of a simple guide and method for their proper placement. Use of the guide is described.

2. There were 100 cases in this series. Sixty-eight cases with a follow-up of one to five and a half years are described herein. All but one of these fractures went on to union.

Acknowledgment: We wish to express our appreciation to Drs. Toufick Nicola, Paul Strassberger, William U. Cavallaro and Vincent Scudese for permission to include twenty-five of their cases in this series

REFERENCES

1. Coleman, S. S., Compere, C. L. and Tachdijian, J. Changes in the femoral head following intracapsular fractures. Scientific Exhibit. American Academy of Orthopaedic Surgeons, Chicago, January, 1957.
2. McIlvenny, R. T. Management of intracapsular hip fractures. *S. Clin. North America*, 29: 31–58, 1949.
3. Modny, M. T. and Kunz, H. G. Insertion of multiple nails in femoral neck fractures. Scientific Exhibit. American Academy of Orthopaedic Surgeons, Los Angeles, January, 1955.
4. Modny, M. T. and Kunz, H. G. Fixation of intracapsular fractures of the femur with multiple nails: result study. Paper presented at American Academy of Orthopaedic Surgeons, Chicago, January, 1957.
5. Moore, A. T. Fractures of the hip joint (intracapsular). *J. South Carolina M. A.*, 30: 10, 1934.
6. Moore, A. T. Fractures of neck of femur; treatment by internal fixation with adjustable nails. *South. Surgeon*, 8: 139–147, 1937.
7. Moore, A. T. Hip joint fracture (mechanical problem). *Am. Acad. Orthop. Surgeons, Lect.*, 10: 35–49, 1953.

Sexual Potency in Aging Males

III. TECHNIC OF AVOIDING NERVE INJURY IN PERINEAL PROSTATIC OPERATIONS

ALEX L. FINKLE, M.D. AND J. B. DEC. M. SAUNDERS, F.R.C.S. (Edin.), *San Francisco, California*

From the Departments of Urology and Anatomy, University of California School of Medicine, San Francisco, California.

FOR many "reasons," perineal prostatectomy purportedly results in a greater incidence of sexual impotency (and urinary incontinence) than other operative approaches to this gland [1]. Actually, many of these reasons prove to be unsubstantiated "impressions" which have been handed down from teacher to pupil for over fifty years [2–3].

Since little is known of the causes or mechanisms of declining sexual potency in aging man, a survey was undertaken at this Medical Center. Results published elsewhere emphasized the need for an acceptable definition of potency and suggested that "psychic desire which leads to coitus and the sensation of ejaculation" was suitable [4]. These results also revealed that libido and potentia decreased after many years of marriage, unrelated simply or exclusively to the age of the patient [4]. For example, older men who had married or remarried relatively recently engaged far more actively and frequently in sexual intercourse than their long-married chronologic contemporaries.

In other publications within this over-all survey, the evidence suggested that psychologic and sociologic factors played perhaps as significant a role in impotency postprostatectomy as the surgical procedure itself [5,6]. Of paramount importance was the manner with which the physician reacted toward the patient's interest in sexual potency; the doctor's encouraging attitude probably aided preservation or recovery of sexual potency and vice versa. As an example of sociologic impact upon sexual potency, the mores of the community or neighborhood could determine the quest for a coital partner by an aging widower, or his resignation to enforced sexual inactivity and frustation.

In the course of pondering numerous facets of the question of sexual potency, the urologist (A. L. F.) consulted the anatomist (J. B. S.) regarding innervation of the male genitourinary apparatus, mainly to seek anatomic definition for the hackneyed term "pelvic nerve injury during perineal prostatic surgery." Discussions elucidated certain neuroanatomical trauma as participating factors in temporary or irreversible impotency following perineal operations. Moreover, it became evident that awareness of some precautions could minimize the likelihood of specific neural injuries during perineal operations.

The present paper depicts some specific anatomic considerations and some essential operative steps in perineal prostatectomy. It is suggested that attention to these points may facilitate the surgical procedure and may contribute to preservation of these patients' sexual potency.

ANATOMICAL CONSIDERATIONS

In the perineal approach to the prostate, the levator ani must be dissected off Denonvilliers' fascia in order to expose the posterior surgical capsule of the prostate. (Fig. 1.) Whether this exposure be achieved by the classical Young [7] approach or the Belt [8] modification, no damage need be inflicted upon rami of the somatically distributed pudendal nerves which pass so far laterally as to escape injury in all but highly unusual instances. (Fig. 2.) However, injury to major parasympathetic fibers may occur if exposure of the distal ends of the seminal vesicles is sought, either to widen the operative field for enucleation of the hyper-

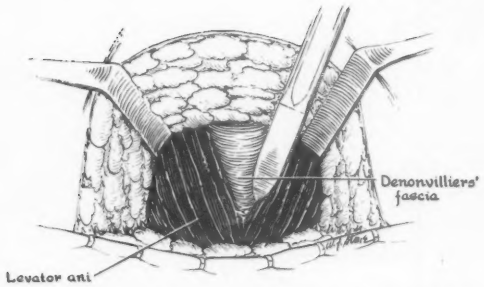


FIG. 1. Surgical entry into perineum has proceeded to depth at which levator ani can be dissected laterally off prostate by scalpel handle, exposing Denonvilliers' fascia.

plastic prostatic adenoma, for subtotal excision of the surgical capsule of this gland, or for radical prostatectomy.

Avoidance of such injury is feasible. Technic for minimizing or obviating this neural trauma will be described herein.

Review of the chief vegetative nerve supply to the penis and bladder reveals important anatomic relationships. The parasympathetic outflow to the genitourinary apparatus is derived from the sacral nerves 2, 3 and 4, but mainly S2 and 3. Although generally called the "pelvic nerve," this designation is inaccurate in man and fails to suggest its plexiform character. (It is actually a part of the hypogastric plexus.) This surprisingly broad collection of fibers (Fig. 2) passes superior (viz., "deep") to the levator ani muscles and is contained within its own fascial sheath. It continues forward, lateral to the apex of the prostate, supplying the bulb of the penis and then terminating in the corpora cavernosa of the penis. Many of the fibers en route to the penile bulb ascend to the bladder, conveying motor impulses. That portion contiguous with the prostatic apex is termed, rather inaccurately, the "prostatic plexus."

Since these parasympathetic fibers terminate in the erectile tissue of the penis, damage of sufficient severity involving enough of the prostatic plexus could impair or destroy penile erection. Moreover, such injury could disturb detrusor function, leading to vesical atony of variable severity.

SURGICAL TECHNIC

As suggested by Morgan and Saunders in 1950, blunt or sharp trauma to the (sacral) parasympathetic outflow seriously interferes

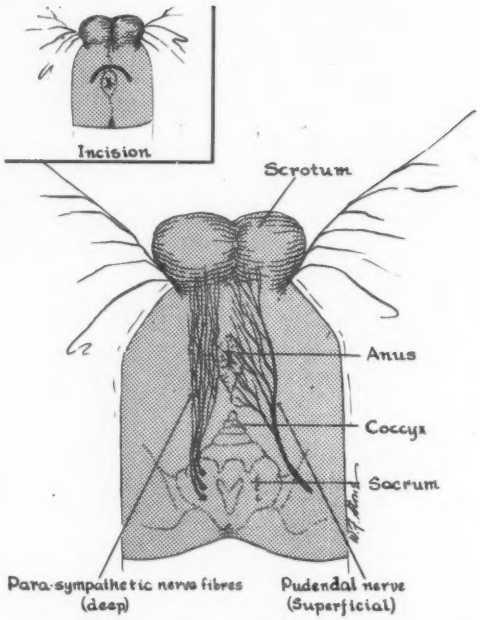


FIG. 2. Insert shows incision in skin by which previous dissection (Fig. 1) was begun. Note superficial location of pudendal nerve which extends along internal aspect of ramus of ischium (bone not shown) and terminates "external" to levator ani. The parasympathetic fibers lie deep ("internal") to the levator ani.

with penile erection and bladder function [9]. Such injury occurs when *sharp lateral transection* of Denonvilliers' fascia is carried out at the level of the distal ends of the seminal vesicles, or slightly more cephalically, as in dissection for radical perineal prostatectomy. (Fig. 3.)

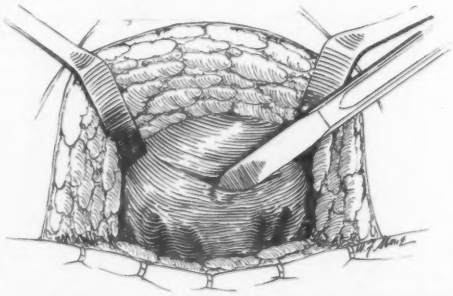


FIG. 3. Shallow transverse incision permits enlargement of the space (shown by scalpel handle) between posterior and anterior layers of Denonvilliers' fascia. For diagrammatic purposes, the distal ends of the seminal vesicles are placed more distally than is anatomically correct.

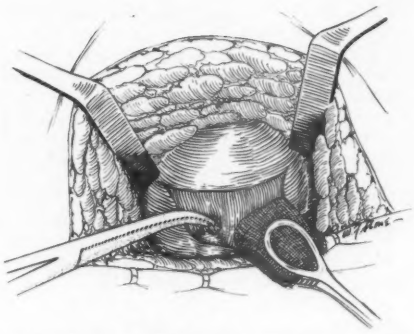


FIG. 4. Further separation of the two layers of Denonvilliers' fascia. The sponge holds the posterior layer downward; the small gauze sponge is used to extend the dissection proximally at the seminal vesicles.

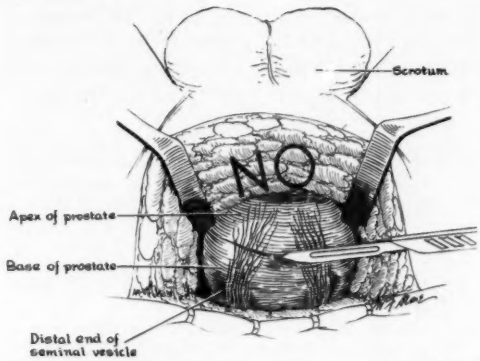


FIG. 5. Mechanism of trauma to parasympathetic fibers: transverse incision extends through both layers of Denonvilliers' fascia at or proximal to distal ends of seminal vesicles, injuring or cutting nerve fibers.

It is emphasized that *blunt* dissection of the space between the rectum and the base of the prostate will spare trauma to the parasympathetic fibers. (Fig. 4.) This involves a separation between the anterior and posterior layers of Denonvilliers' fascia, whether or not the surgeon chooses to look for, recognize and purposefully accomplish this partition of layers. In most instances, we believe, separation of the two layers of Denonvilliers' fascia is achieved by the blunt dissection just advocated, irrespective of the surgeon's awareness that this division has occurred. Details will now be cited as to surgical steps for minimizing or eliminating damage to the parasympathetic plexus, and thus to sexual and urinary functions.

A sponge, grasped in a sponge stick, is used to depress the rectum, exposing well the base of the prostate and rectum. Now, a similar instrument ("cherry" or "peanut") is used to elevate, *gently* and *step-wise*, Denonvilliers' fascia as it encases the base of the prostate and the distal ends of the seminal vesicles. This maneuver further separates or attenuates the anterior and posterior layers of Denonvilliers' fascia. At this time, posterior and lateral retractors may be inserted, or progressive dissection or transection may be made, for the particular operation at hand.

If a sharp, transverse incision is made (Fig. 5) for the purpose of rapidly opening the space between rectum and seminal vesicles, damage to the parasympathetic fibers is almost inevitable, although the severity of injury may not suffice to prevent penile erection or to produce urinary incontinence. Abstinence from this sharp transection (rather the performance of blunt dissection) represents the entire theme of this report.

COMMENTS

Familiarity with the anatomic course and with the physiological functions subserved by the parasympathetic fibers located in the perineum is mandatory for the surgeon who operates in this area [*10,11*]. The purpose of this report is to direct attention to the anatomic relationship of these nerve sheaths to the levator ani, the base of the prostate and the distal ends of the seminal vesicles.

The surgical technic for separation of the anterior and posterior layers of Denonvilliers' fascia at the level of the distal ends of the seminal vesicles is described. Restraint from sharp transection between the distal ends of the seminal vesicles at or immediately proximal to the base of the prostate will succeed in reducing materially potential deficiencies of sexual and urinary function after perineal prostatic surgery.

SUMMARY

The definition of sexual potency should include the desire for and successful completion of coitus. Psychologic and sociologic factors greatly affect potency; these alone can predispose to or precipitate sexual difficulties following prostatectomy.

Anatomic relationships and probable mechanisms of surgical injury to parasympathetic

fibers in the perineum are cited. Technics are described to avoid the participation of surgical trauma in such urinary and sexual dysfunction as may occur after perineal prostatectomy.

REFERENCES

1. Higbee, D. R. Benign prostatic hypertrophy: comparison of results following suprapubic, transurethral and perineal operative procedures. *J. Urol.*, 56: 83–96, 1946.
2. Colston, J. A. C. Perineal prostatectomy. In: Urology, vol. 3, sec. 15, chap. 7. Edited by Campbell, M. Philadelphia, 1954. W. B. Saunders Co.
3. Rolnick, H. C. The Practice of Urology, vol. 2, pp. 970–971. Philadelphia, 1949. J. B. Lippincott Co.
4. Finkle, A. L., Moyers, T. G., Tobenkin, M. I. and Karg, S. J. Sexual potency in aging males. I. Frequency of coitus among clinic patients. *J. A. M. A.*, 170: 1391–1393, 1959.
5. Finkle, A. L. Discussion of sex and prostatectomy. Ebert, C. E. et al. *Tr. West. Sect. Am. Urol. A.*, 25: 173–176, 1958.
6. Finkle, A. L. Sexual potency in aging males. v. Status after open perineal prostatic biopsy. In press.
7. Young, H. H. The early diagnosis and radical cure of carcinoma of the prostate; being a study of forty cases and presentation of a radical operation which was carried out in four cases. *Bull. Johns Hopkins Hosp.*, 16: 315–321, 1905.
8. Belt, E., Ebert, C. E. and Surber, A. C., Jr. A new anatomic approach in perineal prostatectomy. *J. Urol.*, 41: 484–500, 1939.
9. Morgan, J. W. and Saunders, J. B. Preservation of genito-urinary function in rectal resection. *Proc. Roy. Soc. Med.*, 43: 1081–1083, 1950.
10. Lannon, J. and Weller, E. The parasympathetic supply of the distal colon. *Brit. J. Surg.*, 34: 373–378, 1947.
11. Stahlgren, L. H. and Ferguson, L. K. Influence on sexual function of abdominoperineal resection for ulcerative colitis. *New England J. Med.*, 259: 873–875, 1958.

End Result Study of a Series of Operations for Herniated Intervertebral Lumbar Discs

FREDERICK S. WEBSTER, M.D. AND D. P. SMILEY, M.D., *Lincoln, Nebraska*

From the Lincoln Orthopaedic Center, Lincoln, Nebraska.

IN this series of 200 operations for herniated lumbar discs an attempt was made to evaluate, insofar as was possible, the relative merits and results of surgery with and without bony stabilization. It was believed important to include only those patients who presented the acute symptoms and pathological findings of a definite herniated or extruded disc and in whom operation resulted in the early subsidence of the severe subjective complaints and objective findings. Fifty-four of the 200 patients had complete extrusion of the nuclear substance of the intervertebral disc. Thus, while the patients included herein had the expected relief of the acute symptoms of pain in the back and legs following surgery, we questioned the long term result and the subsequent influence of disc herniation on the elements of the disc itself as well as the adjacent structures of the low back, and wondered whether or not the additional surgical procedure of stabilization was warranted at the time of the original exploration and excision of the disc.

These patients were operated upon by us or our associates, with a smaller number being treated on the Orthopaedic Service of the Veterans Hospital, Lincoln, Nebraska.

The follow-up period of the entire series ranged from two to ten years. Each patient had a complete trial of conservative management without relief prior to surgery.

A total of 190 myelographic studies were made prior to surgery and, with the exception of seven patients who had equivocal myelographic findings, x-ray changes were well correlated with the pathologic findings at surgery. Of the seven, a pathologic condition of the disc was found at the lumbosacral level in five, and at the fourth level in two. This proportion would be anticipated because of the relative size of the canal as compared with the dural elements at that level. The total protein evaluation ranged from normal to as high as 90 mg. per cent.

We have classified the results into four groups: excellent, good, fair and poor. Those classified as excellent had complete relief of pain in the back and legs, discarded all brace support, and returned to their previous occupational duties. The majority of the patients in this series were engaged in the occupation of farming which, in itself, places considerable functional requirements upon the back. Those considered good results likewise obtained complete relief from their original complaints and returned to their previous occupational duties. However, they stated that they had occasional backaches, complained of some slight weakness in subsequent follow-up examinations and sometimes required brace support for heavy work.

In our third category of fair were included those patients who had relief of their original pain and symptoms but had some intermittent mild aching of the legs. These patients required brace support for heavy labor. None of those in the first three categories, however, ever exhibited a recurrence of the acute objective findings of persistent severe muscle spasm of the back, and most had definite improvement of objective neurologic changes such as the loss or decrease of reflex activity, motor strength, etc., although at times there was a permanent loss of the Achilles response without significant residuals.

The last group was listed as poor and consisted of those patients who felt their condition was no better than prior to surgery. It is interesting to note, however, that even they demonstrated some degree of early improvement from their original severe complaints.

TABLE I
OPERATIVE RESULTS IN GROUP HAVING DISC EXCISION ONLY

Level of Herniation	Excellent	Good	Fair	Poor	Total
	70 %				
L_5.....	16 (26 %)	27 (44 %)	15 (24 %)	4 (6 %)	62
	58 %				
L_4.....	11 (20 %)	21 (38 %)	20 (36 %)	3 (6 %)	55
L_3.....	2	1	.....	....	3

TABLE II
OPERATIVE RESULTS IN GROUP HAVING DISC EXCISION AND FUSION

Site of Fusion	Excellent	Good	Fair	Poor	Total
	88 %				
L_5:					
L_5-S_1.....	8 (47 %)	7 (41 %)	0	2 (12 %)	17
	79 %				
L_4-S_1.....	12 (43 %)	10 (36 %)	5 (18 %)	1 (3 %)	28
L_4:					
L_4-L_5.....	.....	1	.....	....	1
	79 %				
L_4-S_1.....	17 (52 %)	9 (27 %)	5 (15 %)	2 (6 %)	33
L_3:					
L_3-S_1.....	.....	.....	1	....	1

Of the total 200 patients in this series, 120 had simple excision of the herniated disc only, while in eighty the disc was removed with additional fusion. Including both categories, the herniated disc was located at the L3 level in 2 per cent, at the L4 level in 44.5 per cent, and at the lumbosacral level in 53.5 per cent. Of those undergoing excision of the disc only, sixty-two herniations were found to be at the lumbosacral level, fifty-five at the L4 level, and three at the third lumbar level. Of this group, twenty-nine had excellent results and forty-nine had good results, while thirty-five were fair. There were only seven listed as poor. (Table I.) A slightly higher percentage of patients with herniated discs at the lumbosacral level had a better result than those with herniation at the L4-5 level. However, two patients with herniated discs at the third lumbar level had excellent results. In general, the results were more favorable at the lumbosacral level than at the fourth level. There were not enough herniations at the third lumbar level for statistical comparison.

In the group of patients undergoing removal of the disc with fusion, forty-five had lesions at the lumbosacral level. In twenty-eight of these fusion was effected from the fourth lumbar vertebra to the sacrum inclusive, and in seventeen the single-level fusion was done from the fifth lumbar vertebra to the sacrum. (Table II.) Fifty-three per cent of the lumbosacral disc herniations with fusion classified as excellent results included only the lumbosacral level, while 43 per cent extended into the fourth lumbar vertebra. Although the statistics revealed a relatively higher percentage of good and excellent results with single-level fusion, the over-all satisfactory results were slightly better with longer fusion so that statistically, at least, one could not stress the relative values of shorter or longer fusion. However, with the increased risk of pseudarthrosis, one might be inclined to limit stabilization to the one level when a disc is found at the lumbosacral space. When a lesion was found at the L4 level, fusion included the fourth lumbar vertebrae and the sacrum, with the exception of one instance when fusion was limited to the fourth and fifth lumbar interspaces. There was a total of thirty-four cases in which the disc was found in this position. Statistical results here were comparable to the results obtained at the lumbosacral space. Only one fusion included the third lumbar interspace for a disc between L3 and L4, and although this patient exhibited pseudarthrosis, the result was listed as fair since the patient was satisfied with the outcome and was doing heavy labor but used a brace support. He did not desire refusion.

Percentagewise, 65 per cent of patients with disc removal only had good or excellent results, while 80 per cent with disc removal and fusion revealed good or excellent results. (Table III.) This statistical difference of 15 per cent corre-

TABLE III
TOTAL STATISTICS FOR BOTH GROUPS

Procedure	Excellent	Good	Fair	Poor	Total
	80 %				
Disc excision with fusion.....	37 (46 %)	27 (34 %)	11 (14 %)	5 (6 %)	80
	65 %				
Disc excision only.	29 (24 %)	49 (41 %)	35 (29 %)	7 (6 %)	120
	71 %				
Total.....	66 (33 %)	76 (38 %)	46 (23 %)	12 (6 %)	200

sponds to other recorded statistics with reference to disc surgery with and without fusion. Those listed with excellent results, however, showed a greater degree of variation, being 24 per cent in the group having disc excision only and 46 per cent in those having disc removal and fusion.

Grouping all satisfactory results, including the excellent, good and fair, both groups showed 94 per cent improvement and both exhibited 6 per cent poor results. Thus, it would appear that either procedure would give essentially an equal degree of satisfactory result. However, in the degree of response over a moderately long follow-up period those with fusion were superior.

The one case of disc herniation at the third lumbar level with fusion resulted in a pseudarthrosis between the third and fourth lumbar vertebrae. Of the other three patients without fusion at this level, two had an excellent result and one a good result. Therefore, it would seem that fusion should not be performed because of the possibility of the additional risk of pseudarthrosis.

Pseudarthrosis through the bone graft was radiologically demonstrated in seven patients in this series, for a total of approximately 9 per cent among eighty who had fusion. In addition to the pseudarthrosis occurring between the third and fourth level, as mentioned previously, there were six other instances, all of which occurred in two-level fusions: two for discs at the lumbosacral level and four for discs at the fourth lumbar level.

One of these patients showed a line of pseudarthrosis at the lumbosacral level. In the other instances of pseudartheosis, the defects were between the fourth and fifth lumbar levels. It is possible that there were other patients with pseudarthrosis which was not demonstrated on x-ray and caused minimal complaint. We have utilized both anteroposterior and lateral bending films in addition to oblique films of the fusion areas in follow-up checks for bony stabilization. In our experience, lateral bending films were more apt to demonstrate motion than the anteroposterior ones. In view of the absence of demonstrable pseudarthrosis in one-level fusions, one would further believe that the more extensive stabilization should not be carried out for lesions occurring at the lumbosacral area unless degenerative disc changes are evident at the level above. Two of the seven patients were reoperated upon and demonstrated some definite improvement with complete bony stabilization. The remainder did not desire re-exploration.

Of the 120 patients having disc operations without fusion, three were subsequently fused because of continued complaint. Two of these herniations were at the lumbosacral level and one at the fourth lumbar level. Two of the fusions extended from the fourth lumbar vertebra to the sacrum and one extended over the lumbosacral area. At the time of original surgery all three of these patients exhibited completely extruded nuclear material. Two had a mild structural scoliosis. While all were improved, one showed an excellent final follow-up result.

There were two cases of recurrent discs in this series, one at the fourth lumbar level above a lumbosacral fusion four years postoperatively and the second at the same level (lumbosacral) which originally was not fused. This was stabilized at the second operation. Although there is a chance of recurrence of herniation above the level of a single fusion, this is less likely than the complication percentage of a longer fusion for a lumbosacral lesion.

The appearance of narrowing of the disc space radiologically did not appear to be of direct diagnostic significance, as in several cases rupture of the disc occurred at the level above that of rather marked lumbosacral narrowing. (Fig. 1.) Although this did not always demonstrate a direct correlation with the follow-up results, it is significant of degenerative changes which can exert local influence on the back and which can be prevented by stabilization. It should be noted, however, that some of these patients did not show evidence of disc collapse as long as ten years postoperatively. Some degenerative disc lesions were noted several years prior to eventual operation, and in these there was a demonstrable progressive narrowing of the disc space.

COMMENTS

There are difficulties in the final evaluation of any such series of cases as presented herein because of the requirements based on the subjective interpretation of the individual's discomfort. The original selection of these cases, however, relied on objective criteria including the clinical findings of spasm, neurological change, etc., and, in all but ten,

FIG. 1. Radiologic narrowing of the lumbosacral space with extrusion of disc at the fourth lumbar level. Although narrowing may not have diagnostic significance as to the localization of the herniated disc, fusion is indicated in this situation.

supportive myelographic findings. Since disc degeneration and herniation is a result of a deteriorating process influenced by intrinsic and extrinsic trauma, one might expect that the degree of associated changes, such as osteophytic reaction and disc collapse, as evidenced by roentgenologic findings, would be an important factor in determining the ultimate prognosis. Also, the age of the person by virtue of the same changes would be expected to play an important role. In the series reviewed herein, however, care was taken to review the degree of osteoarthritic change and the presence of narrowing in order to try and correlate these changes with the ultimate result following surgery with or without fusion.

Although osteoarthritic changes in general varied according to age, the average age of these two groups differed only by a span of two years. It was further found that in both those with fusion and without fusion, relatively similar degrees of degeneration, including osteophytic reaction and narrowing of joint space, did not predict to any degree of reliability the outcome according to the follow-up study of the patient. Likewise, there was generally no degree of variation in the amount of osteoarthritic change between the two groups. There was only a two-year average age difference between the two groups, and our original reason for selecting one procedure over the other was largely due to the future work requirements of the patient. That is, the majority of the patients who had fusion in addition to disc excision were those who were doing heavy physical labor, mainly farming. By the same token, the older patients generally were not subjected to this additional operative procedure, but the over-all age groups were similar enough so as not to make this a significant feature.

It is also interesting to note that the average age of the patients having disc and fusion with excellent results was thirty-three years, while those having disc excision only with a similar excellent result averaged thirty-seven years of age. However, in all categories the group with fusion was, on the average, only two years younger. Thus, age itself was not a determining factor here, insofar as results were concerned. Likewise, no correlation could be made as to the degree of osteophytic reaction in end results.

Care was also taken to omit those patients who would receive compensation from any permanent or continuing disability. Narrowing of the intervertebral disc space, as evidenced on routine x-ray examination, was interpreted as a progressive degenerative process which demonstrated considerable variation in degree over a period of years. Progressive collapse of the intervertebral disc space over a period of time was noted in many instances during the course of the ten-year follow-up, some changes being noted prior to operation and others following surgery in some of those without surgical stabilization. (Figs. 2 and 3.) Some, however, as long as ten years after simple disc excision, failed to show any collapse of the interspace. Also, the mere presence of a narrow interspace did not accurately localize the level of disc herniation, as in several instances collapse of the lumbosacral disc space was associated with herniation at the level above. This brings into consideration the factor of whether or not the degenerative changes at the lower level might result in rigidity of movement at that level, throwing greater stress on the one above and influencing disc herniation there. This

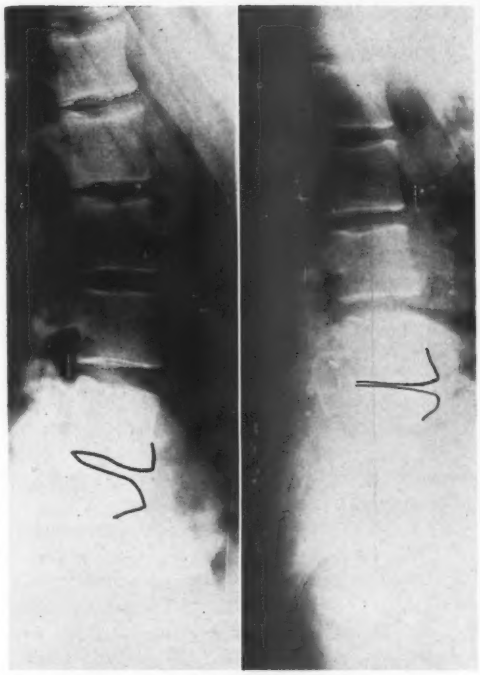


FIG. 2. Appearance of a progressive degenerative disc lesion at the lumbosacral level five years following simple removal. This man does heavy work and is classified as a good result without fusion. This is suggestive of possible future difficulties.

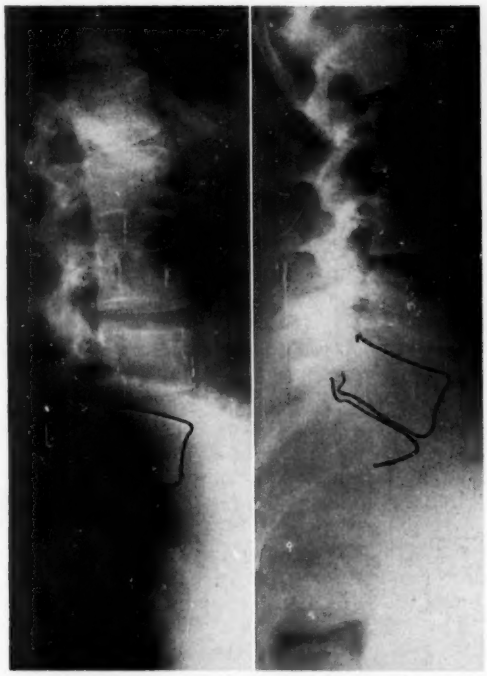


FIG. 3. This illustrates progressive degeneration of the lumbosacral disc level over a period of five years. There was complete extrusion of the nucleus pulposus of the lumbosacral disc which was removed without fusion at initial surgery. Following excellent temporary response, there was recurrence of aching of the back and some pain in the legs without the previous objective clinical findings. Subsequent fusion was therefore effected over the lumbosacral level and rhizotomy was performed at the same time as there was no evidence of recurrent disc herniation or extrusion. There was some definite improvement in subsequent follow-up examination.

would then lead to thoughts of the length of fusion following disc surgery, particularly if the herniation is at the lumbosacral level, and whether or not a single-level fusion would add stress to the disc space above. In our experience, there was only one patient who demonstrated a disc herniation above the level of single fusion. There was also one instance of a recurrent disc at the same level which had not been fused.

In this series the length of fusion for herniation at the lumbosacral level showed only a 10 per cent variation in good and excellent results in favor of a single-level fusion. Although there was one recurrent disc herniation above a single-level fusion in this area, the complication of pseudarthrosis was not demonstrated in any of those with only lumbosacral stabilization. While this complication was found in 9 per cent of the eighty patients who had fusion, it always developed in the longer fusions. Therefore, we believe that complications from pseudarthrosis are greater than the influence on the disc space above a lumbosacral stabilization. The demonstrable presence of pseudarthrosis and the fact that there was the possibility of inaccurately demonstrating other instances in which it might be present makes this a complication of fusion of significant percentage. It does not, however, indicate a necessarily poor prognosis, since two of the seven patients in this series were reoperated upon with some improvement and complete bony union while the remainder progressed well enough that they did not desire reexploration.

CONCLUSIONS

1. Improvement with satisfactory results may be expected in all but a small percentage of

patients operated upon with or without fusion if a lesion requiring surgery is correctly diagnosed. Myelography is a highly accurate aid in this respect.

2. Disc surgery with fusion generally gave superior long term results in this series of 200 cases.

3. Pseudarthrosis, as a complication of fusion, occurs in larger percentages in stabilizations of a greater extent than the lumbosacral level. Thus, fusion in patients with lumbosacral disc disorders should usually be limited to the single level.

REFERENCES

1. Barr, J. S. Ruptured intervertebral disc and sciatic pain. *J. Bone & Joint Surg.*, 29: 429–437, 1947.
2. Eckhert, A. Pathological studies of intervertebral discs. *J. Bone & Joint Surg.*, 29: 447–454, 1947.
3. Lenhart, R. E. End result study of the intervertebral disc. *J. Bone & Joint Surg.*, 29: 425–428, 1947.
4. Love, G. G. Disc factor in low back pain with or without sciatica. *J. Bone & Joint Surg.*, 29: 438–447, 1947.
5. O'Dell, R. T. and Key, A. J. Results of the operative treatment of ruptured intervertebral discs. A.A.O.S. Instructional Course Lectures, vol. 6, pp. 43–47, 1949.
6. Webster, F. S. Myelography and intervertebral disc lesions of the low back. *Nebraska State M. J.*, 36: 386, 1951.
7. Young, H. H., Love, G. G., Svien, H. J., Price, R. D. and Kroll, H. G. Low back and sciatic pain, long term results after removal of protruded intervertebral disc with or without fusion. *Clin. Ortbop.*, 5: 128–137, 1955.

Primary Tumors of the Small Intestine

E. Meredith Alrich, M.D., Richard H. Blank, M.D., *Charlottesville, Virginia,* and John J. Fomon, M.D., *Miami, Florida*

From the Department of Surgery, University of Virginia School of Medicine, Charlottesville, Virginia.

Neoplasms of the small intestine appear infrequently when compared with tumors involving other portions of the gastrointestinal tract. This fact is impressive when one realizes that the small bowel comprises approximately 75 per cent of the length and perhaps over 90 per cent of the internal surface of the alimentary canal. This apparent immunity to tumor formation has been attributed to several factors: (1) the intestinal content is liquid and alkaline, (2) there is essentially no stasis in the small intestine, (3) the incidence of embryonal rests is very low, and (4) a specific protective hormonal or chemical factor may be present in the intestinal mucosa [*1*].

The relative incidence of the various types of tumors of the small bowel is difficult to determine. When autopsy and clinical material are combined, benign lesions are more frequent than malignancies [*2,4,10*]. However, if only those patients with clinical evidence of disease are investigated, there is a significant predominance of malignant tumors [*2–5*].

In spite of their rarity, these lesions occur with sufficient frequency to warrant consideration in the differential diagnosis of unexplained abdominal pain or gastrointestinal bleeding.

The literature relating to tumors of the small intestine is extensive, and it hardly seems warranted to report small series of patients. However, on close inspection of the majority of reports it is apparent that the method of documenting cases is varied, and one has difficulty in making a survey study in the hope of evolving the natural history of the various types of lesions of the small bowel found clinically. It is for this reason that we have undertaken a review of the cases of neoplasms of the small bowel encountered at the University of Virginia Hospital during the past twenty-five years. It is hoped that by recording the protocols of the cases in sufficient detail, these data may be useful in the compilation of a review study at some later date. (Tables I and II.)

UNIVERSITY OF VIRGINIA SERIES

All cases of primary tumors of the small intestine seen at the University of Virginia Hospital since 1932 were reviewed, and the microscopic sections of these lesions were re-examined by Dr. David Smith. Cases of tumors found incidentally at surgery or autopsy were excluded. Six cases were eliminated because of inadequate histologic data. Those lesions which were primary in the ampulla of Vater, having their origin from duodenal mucosa, common duct mucosa or pancreas, were excluded because, in our opinion, these tumors are not germane to the subject of tumors of the small intestine. Twenty-two tumors primary in the small intestine were considered suitable for this study and have been divided into a malignant and a benign group with subclassifications as noted in Table III.

The predilection of specific tumors to various segments of the intestine can be noted in collected reports. Cameron observed that in 200 cases of carcinoma of the jejuno-ileum, the lesion appeared in the proximal jejunum in 40 per cent, the distal ileum in 28 per cent and in the intervening segment in 32 per cent [*6*]. Lymphosarcomas [*7*] and argentaffin tumors [*8*] occur more frequently in the ileum, while leiomyomas and leiomyosarcomas [*9*] have a more even distribution throughout the small intestine.

The most characteristic symptom in both the benign and malignant group is para-umbilical pain, and this was true of 75 per cent of the cases in our series. Acute obstruction occurred in four of the twenty-two cases, while symptoms

TABLE 1

MALIGNANT TUMORS OF THE SMALL BOWEL

Case No.	Age (yr.), Race and Sex	Symptoms and Physical Findings	Operative Findings	Procedure	Follow-up Study
			Reticulum Cell Sarcoma (Two Cases)		
1	69,W,M	Abdominal pain and alternating constipation and diarrhea for 2 mo.; 5 cm. hard mass in right upper quadrant for 2 wk.	Tumor mass in mid-ileum, invading mesentery	Segmental resection, end-to-end anastomosis	Patient died 8 yr. postoperatively of heart disease
2	55,W,F	Cramping pain in right lower quadrant for 4 mo., confirmed on physical examination	Tumor of terminal ileum	Resection of terminal ileum, cecum, ascending colon; ileotransverse colostomy	Patient died 3 days postoperatively of pulmonary embolus
			Adenocarcinoma (Five Cases)		
3	65,W,F	Cramping abdominal pain, alternating constipation and diarrhea, 10 pound weight loss for 8 mo.; bright blood in stools; distended tympanitic abdomen, 12 cm. narrowed sigmoid on barium enema; stool, 2 plus benzidine-positive	Tumor arising from terminal ileum filling cul-de-sac	Resection of terminal ileum, ileotransverse colostomy	Patient died 8 mo. postoperatively
4	49,N,M	Epigastric fullness with occasional nausea and vomiting for 4 yr.; persistent vomiting for 1 wk.; gastrointestinal series showed jejunal obstruction	Tumor of proximal jejunum at ligament of Treitz, metastasis	Palliative gastrojejunostomy	Patient died on sixth postoperative day
5	53,W,F	Abdominal distention, nausea and vomiting; free fluid in peritoneal cavity	None; autopsy showed carcinoma of proximal jejunum with complete obstruction, perforation, localized peritonitis, Laennec's cirrhosis	None	Patient died on thirteenth postoperative day
6	74,W,F	Cramping pain in right lower quadrant, distention, nausea and vomiting for 1 mo.; temperature, 101°F.	Papillary carcinoma of intraluminal, proximal ileum with almost complete obstruction	Segmental resection, end-to-end anastomosis	None
7	41,W,F	Dull pain in paraumbilical region radiating to back and easy fatigability for 3 yr.; 6 by 8 cm. firm, movable mass in left upper quadrant; hematocrit, 22%; stool, 4 plus for blood; gastrointestinal series showed carcinoma of jejunum (Fig. 1)	Tumor of proximal jejunum extending retroperitoneally to involve major vessels	Palliative jejunojejunostomy and jejunotransverse colostomy	Patient died 2 mo. postoperatively

TABLE 1 (*Continued*)

MALIGNANT TUMORS OF THE SMALL BOWEL

Case No.	Age (yr.), Race and Sex	Symptoms and Physical Findings	Operative Findings	Procedure	Follow-up Study
			Carcinoids (Four Cases)		
8	47,W,F	Epigastric pain and vomiting, tenderness in right upper quadrant for 3 mo.; gastrointestinal series showed questionable duodenal ulcer	Ulcer in first portion of duodenum	Subtotal gastrectomy	Exploration 4 yr. later for ulcer revealed no metastasis
9	45,W,M	Cramping epigastric pain and sensation of reduced stomach capacity for 4 mo.; gastrointestinal series showed polypoid mass in base of duodenal bulb	Papillary lesion (0.75 cm.) on wall of first portion of duodenum	Excision of lesion with button of adjacent duodenal wall	Patient well 6 mo. postoperatively
10	61,W,M	Intermittent episodes of abdominal distention for 2 yr.; visible and palpable peristalsis in left upper quadrant; film of kidney, ureter and bladder showed chronic small bowel obstruction (Fig. 2)	Large mass at jejunoileal junction invading large segment of mesentery	Ileum resected except for distal 3 cm., end-to-end anastomosis (tumor left)	Patient well 7 mo. postoperatively
11	34,W,F	Mass appearing intermittently in left lower quadrant and 6 cm. mass in left paraumbilical region for 8 mo.	Tumor arising from mid-ileum, serosa puckered, metastases to mesentery and liver	Palliative side-to-side anastomosis	Patient died 3 mo. postoperatively
			Leiomyosarcoma (Two Cases)		
12	50,W,M	Right paraumbilical pain, constipation, weakness, weight loss for 18 mo.; hematocrit, 28%; stools, 4 plus for blood; gastrointestinal series showed questionable duodenal deformity	Tumor mass in distal jejunum attached to pelvic peritoneum	Resection of involved jejunum and peritoneum, inadequate margin	None
13	53,W,F	Intermittent abdominal pain for 2 yr.; two large extraluminal tumors removed from bowel wall elsewhere	No residual tumor 2 mo. following original procedure	Re-exploration, 17 cm. segment of ileum removed at previous site of tumor	Patient well 5 yr. postoperatively

Continued on following page

TABLE 1 (*Continued*)
MALIGNANT TUMORS OF THE SMALL BOWEL

Case No.	Age (yr.), Race and Sex	Symptoms and Physical Findings	Operative Findings	Procedure	Follow-up Study
			Lymphosarcoma (Two Cases)		
14	45,W,M	Cramping abdominal pain with intermittent constipation and diarrhea for 1 yr.; small bowel study suggested tumor	Segment (5 cm.) of jejunum thickened to diameter of 4 cm.; metastasis to regional nodes	Segmental resection, end-to-end anastomosis	Recurrence 6 yr. postoperatively
		Recurrence of obstructive symptoms	Lesion similar to primary	Segmental resection, end-to-end anastomosis, subsequent x-ray therapy	Patient well 5 yr. postoperatively
15	38,W,M	Abdominal tenderness in right lower quadrant for 4 days; 8 cm. firm mass	Mass (8 cm.) involving entire circumference of terminal ileum	Segmental resection, end-to-end anastomosis	None

of intermittent partial obstruction were encountered in over 50 per cent of the series. Melena, or acute gastrointestinal bleeding, was present in only three cases in this group. The most common change in bowel function was that of alternating constipation and diarrhea. The most frequent physical finding was a palpable mass. Physical findings other than those associated with some degree of obstruction of the small bowel were rare and non-specific when present. Anemia was present in five cases, i.e., hemoglobin was 11 gm. per cent or less; the stool contained blood in six cases.

The x-ray findings were confirmatory or suggestive of the correct diagnosis in eight cases. In retrospect, there were x-ray findings in two additional cases which should have suggested the correct diagnosis of neoplasm of the small bowel.

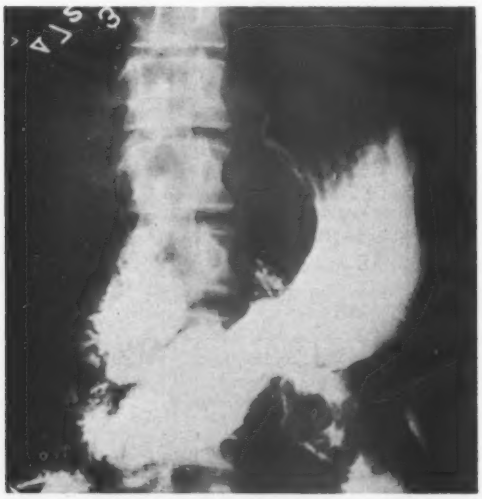


FIG. 1. Case 7. Gastrointestinal series demonstrates a filling defect in the proximal jejunum. A preoperative diagnosis of jejunal carcinoma was confirmed at operation.

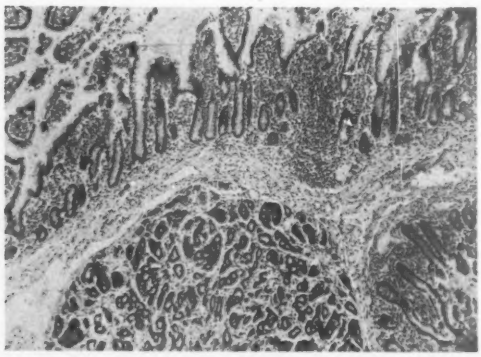


FIG. 2. Case 10. Microscopic appearance of a carcinoid tumor involving the jejunum. Notice the well formed acini with uniformity of nuclear staining. There is no cellular pleomorphism or evidence of malignancy.

TABLE II

BENIGN TUMORS OF THE SMALL BOWEL

Case No.	Age Race and Sex	Symptoms and Physical Findings	Operative Findings	Procedure	Follow-up Study
			Fibroma (Two Cases)		
16	55,W,M	Para-umbilical pain for 6 yr.; mass in right lower quadrant	Firm white tumor (6 cm.) mass arising from terminal ileum	Local excision	Patient asymptomatic for 9 yr.
17	72,N,M	Abdominal pain, nausea and vomiting for 2 days; mass in left upper quadrant	Large tumor mass arising from wall of ileum	Segmental resection, end-to-end anastomosis	None
			Lipoma (One Case)		
18	82,W,M	Nausea and vomiting, deep jaundice for 11 mo.; gastrointestinal series showed 3 cm. polypoid mass in duodenum	Reticulosarcomas of liver previously diagnosed by peripheral node biopsy; lipoma, first portion of duodenum	Local excision	None
			Leiomyoma (Two Cases)		
19	64,W,M	Weight loss, weakness and anemia for 1 mo.; barium enema showed filling defect of cecum (Fig. 3)	Tumor (4 cm.) arising from antimesenteric border on broad pedicle	Segmental resection, end-to-end anastomosis	Patient well 2 yr. postoperatively
20	78,W,M	Cramping abdominal pain, distended abdomen for 3 days; gastrointestinal series showed questionable small bowel tumor	Intussusception at region of jejunum by polypoid tumor mass	Resection of intussusception of jejunal segment including tumor, end-to-end anastomosis	None
			Adenoma (One Case)		
21	29,W,F	Abdominal pain for 24 hr. with distention	Intraluminal adenomatous polyp	Segmental resection, end-to-end anastomosis	None
			Neurilemmoma (One Case)		
22	57,W,M	Intermittent tarry stools for 18 mo.; 4 plus blood in stools, anemia (hemoglobin, 45 mg. %); x-ray of small bowel showed questionable jejunal tumor	Tumor mass (3 by 4 cm.) extending both intra- and extraluminally with ulceration of overlying mucosa	Segmental resection, end-to-end anastomosis	Patient well 11 yr. postoperatively

FIG. 3. Case 19. Appearance at operation of a leiomyoma of the distal ileum. In spite of the extraluminal growth of this lesion, there was a history and laboratory evidence of significant intestinal bleeding in this patient.

Surgical resection was accomplished in all of the benign group. Curative resection was performed in nine cases and palliative resection in five cases in the malignant group. Operation was refused by the remaining patient in the malignant group; the patient died, and positive diagnosis was made at postmortem. In the operated group there were two hospital deaths, one from pulmonary embolus on the third postoperative day and one from advanced metastatic disease on the sixth postoperative day. All patients in the benign group survived without recurrent symptoms. In the malignant group three patients have survived five years or longer without recurrent disease, and two patients have lived from one to four years without recurrence.

COMMENTS

These tumors, whether benign or malignant, produce symptoms dependent upon both the type of tumor present and its location. The majority of symptoms are related to disturbances in the orderly progression of the intestinal content. These may vary from mere irregularities in peristalsic waves to complete obstruction. Secondary anemia and local irritative phenomena of the lesion contribute to the symptomatology in a significant number of cases.

The obstructive symptoms are produced in two ways. First, the acute symptoms of complete intestinal obstruction are the result of intussusception of the bowel, the tumor being the cause of the intussusception (Case 20).

TABLE III

Benign	No. of Cases	Malignant	No. of Cases
Fibroma	2	Adenocarcinoma	5
Lipoma	1	Carcinoid	4
Leiomyoma	2	Leiomyosarcoma	2
Adenoma	1	Lymphosarcoma	2
Neurilemmoma	1	Reticulum cell sarcoma	2
Total	7	Total	15

Second, the symptoms of partial obstruction are caused by gradual compromise of the lumen of the bowel by encroachment of the tumor. This occurs less frequently and at first gives rise to vague intermittent symptoms (Cases 7 and 17). Bleeding may be acute with exsanguinating hemorrhage (Case 22) but usually is occult in nature and manifest by secondary anemia and weakness (Case 12). Gastrointestinal bleeding of undetermined origin should always suggest the possibility of the existence of a tumor of the small bowel, and appropriate studies should be instituted to substantiate or rule out this diagnosis. A leiomyoma or leiomyosarcoma is more likely to give rise to bleeding than are other tumors because of its tendency to undergo tissue necrosis with the development of an ulcer crater. On x-ray examination, this ulcer crater in the tumor is sometimes visualized as a diverticulum-like process.

The symptoms arising from local irritability secondary to tumor are atypical and difficult to evaluate. Not infrequently the patient will have melena and relatively typical symptoms of an ulcer without satisfactory confirmatory roentgenological evidence of such a lesion. In these instances, as in patients with vague symptoms suggestive of "chronic appendicitis," disease of the gallbladder or chronic pancreatitis, careful and adequate roentgenologic study of the small bowel may lead to a positive diagnosis at an early stage of the tumor (Case 14).

The majority of these tumors are overlooked in the course of routine examination of the gastrointestinal tract. In recent years the roentgenologist has intensified his interest in this group of lesions and, as a result, there has been an increase in preoperative diagnosis by roentgenology. The x-ray studies must be made specifically for study of the small bowel. Scout

films of the abdomen, with the patient both in recumbent and upright positions, should be a preliminary to the visualization of the small bowel by opaque material. The cardinal roentgenological findings consist of the following: (1) dilatation proximal to an area of constriction, (2) a filling defect or loss of the normal mucosal pattern, (3) delayed passage of the barium meal (longer than eight hours) through the intestinal tract, and (4) disturbance of motility resulting in segmentation of the barium in the small bowel.

Symptoms of the gastrointestinal tract such as those related herein should strongly suggest the possibility of tumor of the small bowel. Definitive x-ray studies should offer reliable diagnostic confirmation, and resection of the tumor by a liberal margin in most instances with early detection will offer a curative result.

SUMMARY

Twenty-two cases of tumors of the small bowel treated at the University of Virginia Hospital over a twenty-six-year period are reviewed. The primary purpose of this effort is to record in chart form the pertinent data concerning these cases so that large clinical reviews in the future might utilize them in compiling statistical conclusions.

A brief summary of the findings in these cases is presented.

REFERENCES

1. Feldman, M. Multiple primary carcinomas of the small intestine: a review of the literature. *Am. J. Digest. Dis.*, 20: 1, 1953.
2. Raiford, T. S. Tumors of the small intestine. *Arch. Surg.*, 25: 122, 1932.
3. Dundon, C. C. Primary tumors of the small intestine. *Am. J. Roentgenol.*, 59: 492, 1948.
4. Rankin, F. W. and Newell, E. Benign tumors of the small intestine. *Surg., Gynec. & Obst.*, 57: 501, 1933.
5. Bernstein, J. S. and Chey, W. Y. A clinical study of 109 cases. *J. Mt. Sinai Hosp.*, 25: 1, 1958.
6. Cameron, A. L. Primary malignancy of the jejunum and ileum. *Ann. Surg.*, 108: 203, 1938.
7. Marcuse, P. M. and Stout, A. P. Primary lymphosarcoma of the small intestine. *Cancer*, 3: 459, 1950.
8. Dockerty, M. B. Carcinoids of the gastrointestinal tract. *Am. J. Clin. Path.*, 25: 794, 1955.
9. Starr, G. F. and Dockerty, M. B. Leiomyomas and leiomyosarcomas of the small intestine. *Cancer*, 8: 101, 1955.
10. Elias, W. S., Lund, C. C. and Yonemotor, R. Neoplasms of the small intestine. *Am. J. Surg.*, 88: 384, 1954.

Experimental Evaluation of Grafts in the Canine Inferior Vena Cava

HAROLD A. COLLINS, M.D., *Nashville, Tennessee,* GEORGE BURRUS, M.D. AND MICHAEL E. DE BAKEY, M.D., *Houston, Texas*

From the Cora and Webb Mading Department of Surgery, Baylor University College of Medicine, Houston, Texas. Supported in part by U. S. Public Health Service grants Nos. H-3137, H-3779, and H-5187.

DESPITE the variety of arterial grafts which have proved suitable experimentally and clinically, a completely satisfactory venous substitute is not available. Venous grafts are desirable clinically for large veins involved by obstruction, neoplastic invasion, congenital anomalies and extensive laceration. Sporadic reports of successful clinical grafting procedures for large veins appear [*10,12,16,17*], but frequently, the period of postoperative observation is short and the patency of the grafts is assumed from clinical appearance of the patient.

Numerous factors may be responsible for the failure of venous grafts, including low pressure, low flow, operative trauma, reaction of the host to homologous and synthetic substitutes, and lack of rigidity of the graft. The present series of experiments was designed to evaluate the influence of the type of venous graft on the incidence of thrombosis in the canine inferior vena cava. Under standard conditions an infrarenal portion of the inferior vena cava was resected and replaced by autogenous aorta, a crimped dacron graft or a tube fashioned from autogenous peritoneum. As a control, in another group of dogs, a segment of the inferior vena cava was resected and then anastomosed in its previous position.

METHODS

Mongrel dogs weighing from 6 to 15 kg. were used. Anesthesia was induced by the administration of pentobarbital in standard veterinary dosage. All operations were performed with sterile technic. The abdomen was entered through a right rectus incision. Following application of atraumatic clamps, a 3 to 4 cm. segment of inferior vena cava was excised. The venous anastomoses in all animals were performed similarly. After the placement of stay sutures halfway about the circumference, the anastomosis was completed with an over-and-over continuous suture of No. 5–0 silk. With the exercise of care, significant stenosis did not occur at the suture line. Penicillin and streptomycin were administered for the first three postoperative days. Vena cavograms through the femoral veins using 70 per cent Urokon® were performed at three week intervals until complete occlusion of the graft was demonstrated. Autopsy was performed in all animals to examine the grafts.

In the eight dogs comprising group I, a 3 to 4 cm. segment of the inferior vena cava was excised, the segment reversed in direction and anastomoses to the proximal and distal ends of the vena cava performed. In eight dogs in group II the excised segment of inferior vena cava was replaced by a similar length of crimped dacron tube approximately 9 mm. in diameter. (Fig. 1.) Group III consisted of eight dogs in which the resected segment of inferior vena cava was replaced by a tube of autogenous peritoneum. (Fig. 2.) A rectangle of parietal peritoneum was excised from the abdominal wall and fashioned into a tube, with the serous surface inward, about a piece of glass tubing of appropriate size. The opposing edges of the peritoneum were sutured with a continuous suture of No. 5–0 silk after the peritoneum had been trimmed to the approximate size of the vena cava. The peritoneal tube was then anastomosed into the inferior vena cava. In the six dogs of group IV, similar lengths of adjacent inferior vena cava and abdominal aorta were

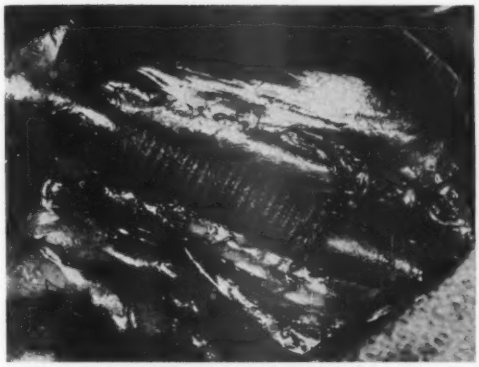


FIG. 1. Crimped dacron graft anastomosed into infrarenal inferior vena cava.

FIG. 2. Tube of autogenous peritoneum used to replace segment of inferior vena cava.

excised. The excised aortic segment was then anastomosed into the vena cava and the vena caval segment into the aorta. In most instances the aortic segment was slightly smaller in diameter than the vena caval segment.

RESULTS

Five animals did not survive operation, usually due to anesthetic errors, and these were excluded from further consideration. The method of suture anastomosis proved satisfactory and produced little constriction at the suture line. After completion of the anastomoses and removal of the clamps there was little bleeding from any of the grafts, and blood flow appeared to be satisfactory at the conclusion of the operative procedure. Peripheral edema was not apparent in any animal postoperatively although the anterior abdominal veins frequently became prominent after thrombosis of the graft.

In no instance did a graft remain patent longer than four months. (Table 1.) When a graft was patent three weeks postoperatively, serial venograms demonstrated a gradual constriction of the graft until ultimate thrombosis occurred. Coincident with thrombosis of the graft, an extensive collateral system (Fig. 3) developed which was of sufficient magnitude to prevent the occurrence of edema in the hind quarters. The longest period of patency, fifteen weeks, was in a control vena caval anastomosis. (Fig. 4.) The autogenous venous grafts of the aorta in the dogs of group IV all remained patent as evidenced by the presence of femoral pulses and examination at autopsy.

TABLE 1

Group and No. in Group	No. of Grafts Patent at:		
	3 Wk.	6 Wk.	4 Mo.
Group I—control inferior vena caval anastomosis (8)	5	2	0
Group II—dacron graft (8)	3	1	0
Group III—autogenous peritoneal graft (8)	3	1	0
Group IV—autogenous aortic graft (6)	1	0	0

The findings at autopsy were fairly uniform and consisted of occlusion of the graft by perivascular constriction of fibrous tissue at the area of grafting. Usually there was a small thrombus extending the length of the graft. The dacron grafts were collapsed and wrinkled while the other grafts tended to be incorporated into the fibrous tissue.

COMMENTS

Various materials have been used experimentally as venous grafts by different investigators with divergent results. Included in various studies were arterial and venous autografts [*5,14*] and homografts [*6,9*]; autogenous pericardial grafts [*11*]; nylon [*2*], dacron [*6*], polyvinyl [*11*], amylon [*15*], silicone rubber [*15*], orlon [*2*], teflon [*2*] and lucite tubes with a vein lining [*7*]. Ultimate thrombosis occurred in most grafts if the period of observation was sufficiently long. The most remarkable success

FIG. 3. Vena cavogram demonstrating collateral circulation around a thrombosed dacron graft in inferior vena cava.

FIG. 4. Vena cavogram twelve weeks after control anastomosis of segment of inferior vena cava. Early narrowing at the anastomotic lines is occurring.

has been achieved by Moore and Riberi [*14*] who reported that of thirty-three dogs with replacement of the superior vena cava by fresh autogenous thoracic aorta, patency of the graft was demonstrated in all for periods of one day to twelve months. This observation is in striking variance with the findings in the present series in which fresh aortic autografts had no significant advantage over other types of grafts.

Autogenous grafts possess many theoretical virtues. An attempt was made to assess the value of various autogenous grafts in the vena cava in the present study. A tube of autogenous peritoneum, autogenous aorta and autogenous vena cava were anastomosed into the inferior vena cava. None of these grafts remained patent for long terms. The striking difference between autogenous grafts in the arterial and venous systems was demonstrated by simultaneous grafting of the abdominal aorta with an autogenous vein and the inferior vena cava with autogenous aorta. Despite the fact that both grafts were presumably affected by the same factors other than flow and pressure, the grafts in the aorta uniformly remained patent while those in the vena cava uniformly thrombosed.

The importance of pressure in maintaining the patency of venous grafts was ingeniously evaluated by Bryant and his associates [*2*]. Nylon grafts in the inferior vena cava became occluded in all animals. However, when an arteriovenous fistula was created proximal to a nylon graft in the femoral vein, 75 per cent of the grafts remained patent. When the arteriovenous fistula was created distal to the nylon graft with a resultant lower pressure in the grafted area, all of the grafts thrombosed. This provides additional evidence in support of the concept that intraluminal pressure is the most significant factor in assuring continued patency of venous grafts

While the importance of precise technic in the performance of venous anastomoses is not denied, faulty technic probably does not account for late thromboses in venous grafts.

Commonly the grafts are patent initially but undergo a gradual occlusion during a period of days to weeks. This results from contracting perivascular fibrous tissue which is unimpeded by the low venous pressure.

Crimped dacron grafts [4] are more rigid than the vena cava and were used in this study in an attempt to prevent constriction by fibrous tissue. Progressive collapse and wrinkling of the dacron grafts eventually caused occlusion in all. Rigid lucite tubes with an autogenous venous lining have been used with partial success by Egdahl and his co-workers [7]. Lewis has recently reported the use of a teflon tube inside venous anastomoses [13]. While the anastomosis stayed open, scar tissue at either end caused occlusion.

The high rate of success with autogenous aortic grafts reported by Moore and Riberi has not been duplicated in this study. The reason for this is not apparent unless it is related to the difference in size between the thoracic aortic grafts used by Moore and the abdominal aortic grafts used in this series. Similarly the 80 per cent success rate achieved by Bryant and co-workers using autogenous venous grafts has not been confirmed by Jones and associates [11], Deterling and Bhonslay [6], or the present series.

Little clinical experience with venous replacement is available at this time. Most of the reported cases have been evaluated too early in the postoperative period to warrant any conclusion about long term patency. Occasionally the patency of the graft is assumed from the patient's clinical appearance which may lead to error. The difficulty in evaluating patency of a venous graft except by venography has been emphasized by Crawford and De Bakey [3]. Complete occlusion of an aortic homograft used to replace the inferior vena caval bifurcation was demonstrated by vena cavogram four months postoperatively despite the fact that there was no swelling of the legs or feet.

In our opinion thrombosis of venous grafts is principally related to the low venous pressure. While early occlusion may be related to faulty technic, in most instances obliteration occurs due to a gradual and progressive constriction by perivascular scar tissue. In our experience this reaction is independent of the type of graft used and no one type of graft is clearly superior to another. This experience is further evidence of the limitations in replacing a venous segment with a graft for the purpose of maintaining normal venous flow. In considering the desirability of attempting inferior vena caval grafts below the level of the renal veins, it has been postulated that simple closure of the venous ends might be better than attempted replacement [3].

SUMMARY

The feasibility of replacing the canine inferior vena cava with autogenous peritoneal tubes, dacron grafts and autogenous aorta was assessed. In another group of dogs a portion of the inferior vena cava was divided and anastomosed as a control. Regardless of the type of graft employed, thrombosis universally occurred within four months. No graft demonstrated clear superiority over the others. Thrombosis of the grafts appears to be due to occlusion by perivascular scar tissue. The factors of venous flow and pressure appear to be of more significance in determining continued patency of a venous graft than the type of graft employed.

REFERENCES

1. Ashburn, F. S., Sewell, W. H. and Huggins, C. E. Experimental replacement of the superior vena cava with homologous arteries and report of a case with malignant obstruction replaced with a heterologous artery. *J. Thoracic Surg.*, 31: 618–624, 1956.
2. Bryant, M. F., Jr., Lazenby, W. D. and Howard, J. M. Experimental replacement of short segments of veins. *Arch. Surg.*, 76: 289–293, 1958.
3. Crawford, E. S. and De Bakey, M. E. Wide excision including involved aorta and vena cava and replacement with aortic homograft for retroperitoneal malignant tumors. Report of two cases. *Cancer*, 9: 1085–1091, 1956.
4. Crawford, E. S., De Bakey, M. E. and Cooley, D. A. Clinical use of synthetic arterial substitutes in three hundred seventeen patients. *Arch. Surg.*, 76: 261–270, 1958.
5. Daniel, W. W. Bridging defects in the canine portal and superior mesenteric veins with plastic tubes and vascular grafts. *Cancer*, 5: 1041–1048, 1952.
6. Deterling, R. A. and Bhonslay, S. B. Use of vessel grafts and plastic prostheses for relief of superior vena caval obstruction. *Surgery*, 38: 1008–1026, 1955.
7. Egdahl, R. H., Hume, D. M. and Schlang, H. A. Plastic venous prostheses. *S. Forum*, 5: 235, 1955.
8. Gerbode, F., Vee, J. and Rundle, F. F. Experimental anastomoses of vessels to the heart. Possible application to superior vena caval obstruction. *Surgery*, 25: 556–565, 1949.

9. Gerbode, F. L. Discussion of Scannell and Shaw [17].
10. Holman, C. W. and Steinberg, I. Treatment of superior vena caval occlusion by arterial graft. *J. A. M. A.*, 155: 1403–1405, 1954.
11. Jones, T. W., Stevenson, J. K., Jesseph, J. E. and Harkins, H. N. A critical evaluation of polyvinyl sponge (ivalon) as a vascular and tissue substitute. *Am. Surgeon*, 24: 401–414, 1958.
12. Klassen, K. P., Andrews, N. C. and Curtis, G. M. Diagnosis and treatment of superior vena cava obstruction. *Arch. Surg.*, 63: 311–325, 1951.
13. Lewis, F. J. High defects of the atrial septum. *J. Thoracic Surg.*, 36: 1–11, 1958.
14. Moore, T. C. and Riberi, A. Superior vena caval replacement. III. Successful use of fresh autogenous aorta. *Surgery*, 44: 898–903, 1958.
15. Ohara, I. and Sakai, T. Transplantation of the large venous system with various blood vessel substitutes. An experimental study. *Surgery*, 42: 928–935, 1957.
16. Rousselot, L. H. Autogenous vein grafts in splenorenal anastomosis. A description of technique and its clinical application in seven patients. *Surgery*, 31: 403–410, 1952.
17. Scannell, J. G. and Shaw, R. S. Surgical reconstruction of the superior vena cava. *J. Thoracic Surg.*, 28: 163–174, 1954.

Accidents kill twice as many preschool children as pneumonia, and nearly three times as many as cancer (Metropolitan Life Insurance Company). Currently, fatal accidents in the United States take a toll each year of about 4,700 children past their infancy but not yet of school age. These deaths account for more than one-fourth of the total at ages one to four. This situation nevertheless represents a substantial improvement over that of a few years ago.

Inguinal Hernia in Pediatric Patients

CHARLES W. MCLAUGHLIN, JR., M.D. AND JOHN D. COE, M.D., *Omaha, Nebraska*

From the Department of Surgery, University of Nebraska College of Medicine; and the Childrens Memorial Hospital, Omaha, Nebraska.

INGUINAL hernia represents the most common congenital lesion seen by the surgeon in infants and young children. It is now generally conceded that these hernias should be repaired at once if the general condition of these small patients is satisfactory.

There still is some discussion as to the advisability of exploring the opposite side when the presenting lesion is unilateral. In a previous report [3] our experience with routine exploration of the opposite side in a series of forty-eight infants under the age of three years was recorded. A second hernia was found in 52 per cent of these patients in whom no hernia on the opposite side could be demonstrated prior to exploration. This policy has been continued and our results in the over-all series of patients follow. We have cared for 329 private surgical patients with inguinal hernia, in the pediatric age group, in whom 433 hernias were found. Ninety per cent (296 patients) were males and 10 per cent (thirty-three patients) were females.

The age at which the hernia first made its appearance is listed in Table I. It is noteworthy that in 175 instances (more than 53 per cent of the series) the hernia was apparent during the first year of life in this group of infants. As has been noted by all observers, the presenting hernia was most frequently seen on the right side. (Table II.) The ratio of primary right-sided hernias to left-sided lesions was almost 3:1, while primary bilateral hernias were seen in only 10.7 per cent of the group.

TABLE I
AGE AT WHICH HERNIA WAS FIRST NOTED IN SERIES OF 329 PEDIATRIC PATIENTS

Age	No. of Cases	
Birth to 1 mo.	50	175 (53%)
1–3 mo.	52	
3–6 mo.	48	
6–12 mo.	25	
1–3 yr.	67	
3–6 yr.	62	
6–12 yr.	25	
Total	329	

TABLE II
LOCATION OF INGUINAL HERNIA IN SERIES OF 329 PEDIATRIC PATIENTS

Location	No. of Cases	Per cent
Presenting hernia, right side	218	66.2
Presenting hernia, left side	76	23.1
Presenting hernia, bilateral	35	10.7

In the thirty-five patients with bilateral hernias, the lesions were apparent on the first pediatric examination in twenty-six instances, while in the remaining nine cases the second hernia was apparent when the infant was referred for surgical therapy.

In this series, before a routine policy of exploring the opposite side in patients under the age of three was adopted, a total of nineteen patients returned with the second hernia on the opposite side. In fourteen cases the primary hernia was right-sided and in five instances it was on the left.

During the past five years we have explored the opposite side in the majority of routine herniorrhaphies for unilateral lesions in children under the age of three years. We do not follow this practice in premature infants, in the presence of incarceration, if the anesthetic is not well tolerated, or in the presence of other prohibiting complications.

Our experience in 108 blind explorations is listed in Table III. These figures support our

TABLE III

BLIND EXPLORATION OF OPPOSITE SIDE IN SERIES OF 108 PATIENTS WITH SINGLE PRIMARY HERNIA

	No. of Cases	Per cent		No. of Cases	Per cent
Primary hernia, right side	75	....	Primary hernia, left side	33	....
Hernia found on left side	37	49.3	Hernia found on right side	23	69.6
Hernia not found on left side	38	50.7	Hernia not found on right side	10	30.4

earlier contention that bilateral exploration is both justified and indicated. Hernias were found in the over-all group in 49.3 per cent on the opposite side when the primary lesion was right-sided and in 69.6 per cent when the initial lesion was on the left.

It is well known that this frequency of bilateral lesions is not seen in adult patients with hernia nor is it seen in children in the older pediatric age groups above the age of six. This is evidence of the fact that the vaginal process is often incomplete in infancy and usually closes spontaneously or may remain patent for years without the development of a hernia.

These children subjected to routine exploration of the opposite side were further analyzed by age groups to further clarify this observation. (Table IV.) In a portion of the series analyzed from this standpoint, hernias were found on both sides in 72 per cent of the infants under six months of age; in 44 per cent in the group from six months to one year of age; in 50 per cent of those from one to three years; and in only 42 per cent of those from three to six years. It is again noted that if the primary hernia is left-sided there is almost twice the chance of finding a second hernia on the right side.

The age at which these patients came to operation is listed in Table V. Thirty-eight per cent of the entire group were operated upon during the first year of life and 62 per cent before the third year.

Incarceration remains the most common complication of hernia in this age group, whereas strangulation rarely occurs. A total of thirty-one pediatric patients were admitted with incarceration, twenty being males and eleven females. Twenty-two, or over two-thirds of this group, were under the age of three months, and 84 per cent were under one year of age when admitted. No instance of strangulation was noted, the content of the hernial sac being ileum in seventeen instances, tube and ovary in eleven and cecum and appendix in one case. The mobility of the tube and ovary in the female child makes it especially prone to slide into a patent sac and it is, in our experience, almost a constant occupant of an incarcerated hernia in the female of this age group.

TABLE IV

BLIND EXPLORATION OF OPPOSITE SIDE IN PATIENTS WITH SINGLE PRIMARY HERNIA: CLASSIFICATION BY AGE AT OPERATION

Age at Operation	Per cent of Cases with Hernia Found on Opposite Side
Birth to 6 mo.	72
6 mo.–12 mo.	44
1 yr.–3 yr.	50
3 yr.–6 yr.	42

TECHNIC

In infants and children under the age of three years a small transverse incision projecting medially from the anterosuperior spine in the lower abdominal crease is routinely employed. Very fine instruments and delicate handling of

TABLE V

AGE OF 329 PEDIATRIC PATIENTS COMING TO OPERATION WITH INGUINAL HERNIA

Age	No. of Cases	
Birth–1 mo.	12	38%
1–3 mo.	79	
3–6 mo.	13	
6–12 mo.	23	
1–3 yr.	76	
3–6 yr.	83	
6–12 yr.	43	
Total	329	

tissues are both essential for a successful procedure. The sac is identified and carefully freed to the internal ring where it is ligated, but we do not favor fixation at this point. Modified Ferguson repair using two fine catgut sutures completes the repair of the hernia, and the small incision is closed in layers with a subcuticular skin suture of No. 5-0 catgut. No dressings are employed but the skin incision is painted with compound tincture of benzoin or sprayed with aeroplast. Wound infection has been practically non-existent.

CONCLUSIONS

1. A series of 433 hernias occurring in 329 infants and young children are reviewed.

2. In 53 per cent of the patients in this series the hernia made its appearance during the first year of life.

3. Routine exploration of the opposite side with single primary hernia in pediatric patients under three years of age is advised if the general condition permits.

4. Such routine exploration in this age group demonstrated a 55 per cent incidence of hernia on the opposite side, the figure being 49.3 per cent if the initial hernia is right-sided and 69.6 per cent if the primary hernia is on the left side.

5. Incarceration was the most common complication observed in infants with hernias, 84 per cent of these infants being under one year of age on admission.

6. The surgical repair of inguinal hernia in infancy is a safe and practical procedure, and should be recommended as soon as the diagnosis is made.

REFERENCES

1. Clausen, E. G., Jake, R. J. and Binkley, F. M. Contralateral inguinal exploration of unilateral hernia in infants and children. *Surgery*, 44: 735–744, 1958.
2. Kiesewetter, W. B. Early surgical correction of inguinal hernia in infancy and children. *J. Dis. Child.*, 96: 362–367, 1958.
3. McLaughlin, C. W., Jr. and Kleager, C. The management of inguinal hernia in infancy and early childhood. *J. Dis. Child.*, 92: 266–271, 1956.
4. Potts, W. J., Riker, W. L. and Lewis, J. E. The treatment of inguinal hernia in infants and children. *Ann. Surg.*, 132: 566–567, 1950.

The Inhibition of Russell's Viper Venom by the Water-Soluble Derivatives of Sodium-Copper Chlorophyllin

JOSEPH M. MILLER, M.D., DEBORAH A. JACKSON, B.S. AND CHARLES S. COLLIER,
Fort Howard, Maryland

From the Surgical Service and General Medical Research Service, Veterans Administration Hospital, Fort Howard, Maryland.

SODIUM-copper chlorophyllin [1,2] and sodium-iron chlorophyllin [2] have the ability to inhibit the formation of fibrin clots when thrombin is added to fibrinogen. The water-soluble derivatives of sodium-copper chlorophyllin also inhibit the clotting of human plasma by the coagulase of the Staphylococcus aureus [3]. Russell's viper venom initiates a clotting reaction when it is added to recalcified plasma [4]. Since fibrinogen is protected from coagulant activity by chlorophyllin, it was natural to determine whether chlorophyllin would protect fibrinogen from the coagulant activity induced in recalcified human plasma by Russell's viper venom.

A mixture of a 0.01 per cent solution of Russell's viper venom, Stypven,®* and a 1.0 per cent solution of anhydrous calcium chloride was made. A part of this mixture was added to

* The Stypven was supplied by Burroughs Wellcome & Co., Inc., Tuckahoe, New York.

TABLE 1

RESULTS WITH A 0.2 PER CENT SOLUTION OF THE WATER-SOLUBLE DERIVATIVES OF SODIUM-COPPER CHLOROPHYILLN

Test Tube	Milliliters of Human Plasma	Milliliters of Chloro-phyllin	Milligrams of Chloro-phyllin	Concentra-tion of Chlorophyllin (%)	Milliliters of Distilled Water	Milliliters of Stypven and Calcium Chloride	Result	Time in Hours
1	0.2	0.0	0.0	0.00	1.4	0.4	+	2
2	0.2	0.1	0.2	0.01	1.3	0.4	+	2
3	0.2	0.2	0.4	0.02	1.2	0.4	±	6
4	0.2	0.3	0.6	0.03	1.1	0.4	±	6
5	0.2	0.4	0.8	0.04	1.0	0.4	±	6
6	0.2	0.5	1.0	0.05	0.9	0.4	−	6
7	0.2	0.6	1.2	0.06	0.8	0.4	−	6
8	0.2	0.7	1.4	0.07	0.7	0.4	−	6
9	0.2	0.8	1.6	0.08	0.6	0.4	−	6
10	0.2	0.9	1.8	0.09	0.5	0.4	−	6
11	0.2	1.0	2.0	0.10	0.4	0.4	−	6
12	0.2	1.1	2.2	0.11	0.3	0.4	−	6
13	0.2	1.2	2.4	0.12	0.2	0.4	−	6
14	0.2	1.2	2.4	0.12	0.6	0.0	−	6

NOTE: + = Solid clot present.
± = Loose clot present.
− = Clot not present.

human plasma and a 0.2 per cent solution of sodium-copper chlorophyllin.* (Table 1.) The results showed a critical level of sodium-copper chlorophyllin at which Russell's viper venom was inhibited from clotting recalcified human plasma.

COMMENTS

Sodium-copper chlorophyllin is a water soluble salt which is derived from chlorophyll. A weak acid removes the magnesium in naturally occurring chlorophyll and replaces the metallic ion with hydrogen ion. Copper ion is then substituted for the hydrogen ion. A careful alkaline hydrolysis replaces the methyl ester group and the phytol ester group with sodium ions. Sodium-copper chlorophyllin has a molecular weight of 690. The salt is freely soluble in water and makes a dark green solution. A 0.2 per cent solution has a pH of 7.38. The sodium-copper salt ionizes as the sodium ion and the copper chlorophyllin ion.

The mechanism of the inhibition of the clotting of human plasma by Russell's viper venom is not known. The chlorophyllin may unite with the unchanged fibrinogen or it may form a complex with the fibrin monomer which remains after thrombin acts upon fibrinogen to form the fibrin monomer and a fibrinopeptide. The way in which chlorophyllin is attached to fibrinogen or the fibrin monomer is not known. Chlorophyllin may attach itself to the specific reactor site of thrombin on fibrinogen or to an adjacent receptor site and interfere with the binding of thrombin to fibrinogen by steric hindrance. Chlorophyllin is a large molecule and fibrinogen and fibrin monomer are much larger. All of these molecules offer extensive surfaces for attraction through van der Waals' forces, hydrogen bonds and ionic bonds.

* The sodium-copper chlorophyllin was supplied by the Rystan Company, Mount Vernon, New York.

SUMMARY

The water soluble derivatives of sodium-copper chlorophyllin had the ability to inhibit the formation of fibrin clots when Russell's viper venom was added to recalcified human plasma. An apparent stoichiometric relationship was present between the chlorophyllin and the fibrinogen in the human plasma.

REFERENCES

1. Ablondi, F. B., Miller, J. M. and Frohman, B. Unpublished data.
2. Miller, J. M., Jackson, D. A. and Collier, C. S. The inhibition of clotting by chlorophyllin. *Am. J. Surg.*, 95: 967–969, 1958.
3. Miller, J. M., Jackson, D. A. and Collier, C. S. The inhibition of the coagulase of the Staphylococcus aureus by the water-soluble derivatives of sodium-copper chlorophyllin. *Am. J. Surg.*, 97: 321–323, 1959.
4. Peden, J. C., Jr. and Peacock, A. C. The coagulation of blood by Russell's viper venom and beef serum factors. *J. Lab. Clin. Med.*, 52: 101–108, 1958.

A Study of Ileal Substitution for the Creation of a Continent Urinary Bladder

CHARLES L. REYNOLDS, JR., M.D., *Dallas, Texas*

From the Veterans Administration Hospital and the University of Texas Southwestern Medical School, Dallas, Texas.

THE purpose of this study is to determine the feasibility of creating a continent and closed substitute bladder using a segment of ileum, and to observe its behavior, as well as any chemical disturbance which might be produced.

A review of the many attempts to divert urine after removal of the urinary bladder indicates that the problem has never been completely solved. To be entirely satisfactory, diversion must be cosmetically and functionally acceptable to the patient, with assurance that he will remain in chemical balance and not be subject to ureteral reflux or recurrent infections. Until this can be obtained, surgeons will be reluctant to urge patients to accept total cystectomy and other radical procedures when they are indicated.

HISTORICAL REVIEW

Tizzoni and Foggi [6], in 1888, made a substitute bladder in two dogs by a two-stage procedure, first placing an isolated segment of small bowel between the urethra and skin surface, and implanting the ureters therein. The cutaneous opening was closed at a later date. These dogs were continent and voided once an hour some two months later. Although no chemical studies were made, they were apparently in good health.

Sixty years later Rubin [4] successfully fashioned a substitute bladder from sigmoid in dogs. This was a one-stage procedure, implanting ureters and anastomosing one end of the sigmoid loop into the urethra, leaving the prostate. These dogs regained continence in one week, but there is late evidence that this type of substitute bladder dilates.

In 1912 Heitz-Boyer and Hovelacque [2] created a rectal bladder with a permanent diversionary colostomy, with the anus serving as a vesical sphincter. This has the advantages in that a colostomy is more easily controlled than a urine-draining ileostomy and there are lessened chances of infection as compared with simple ureterosigmoidostomy, but urinary continence is obtained at the price of a colostomy.

In 1950 Bricker [1] reported his excellent and now widely accepted urine-diverting, isolated-segment ileostomy, the technic of which is well known. It provides continuous diversion of urine, thus avoiding selective reabsorption of electrolytes. It drains freely and reflux problems are minimal. A distinct advantage lies in the fact that the loop may be placed high above the pelvis where recurrence of carcinoma of the bladder is less likely to interfere with its function. Mucous plugging is no problem. However, the Bricker procedure has the disadvantages of a continuously draining ileostomy with the necessity for some device for collection of urine, and ascending urinary infections appear to be rather frequent.

The substitute bladder introduced by Shoemaker and Grotzinger [5] attempts to solve the problem of mucous plugging by turning an isolated segment of ileum inside out so that the urine is in contact with serosa. The authors report good functional results but a high mortality rate and a high incidence of ureteral stricture.

In 1956 Pyrah [3] reported three clinical cases of total cystectomy and substitution in which ileum was anastomosed to the urethra. Two were one-stage procedures; the third was done in two stages by a colleague and has not been followed up. Pyrah isolated approximately 21 inches of distal ileum and anastomosed the urethra to the antemesenteric surface. The

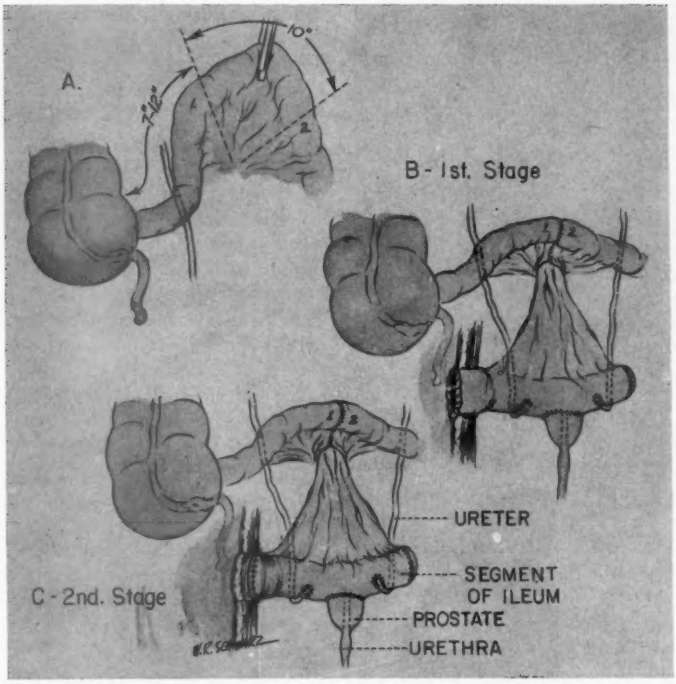


FIG. 1. A, segment of ileum to be isolated. B, ureteral and urethral anastomosis. C, cutaneous opening of ileum closed extraperitoneally.

ureters were implanted bluntly into the very distal and proximal ends of the loop. One of Pyrah's patients died. The other is reported to be happy, and is continent in the daytime but not while asleep. He has no chemical imbalances.

EXPERIMENTAL STUDY

Our experimental operations on twenty dogs have included both single- and dual-stage operations, and a variety of methods of ureteral implantations.

Operative Preparations. The animals were prepared for operation by administering Neothaladine® tablets, 2 gm. four times daily for three days, and 2 ounces of milk of magnesia forty-eight hours prior to surgery. For twenty-four hours prior to operation they had free access to water but no food. The animals were anesthetized with 2.5 per cent sodium Pentothal® as a continuous intravenous drip.

Technic of the One-Stage Procedure. A median incision is made from the umbilicus to the symphysis pubis. In male animals the vas deferens is ligated to facilitate exposure of the bladder. The terminal 4 or 5 inches of both ureters are isolated, taking care not to injure their parallel blood supply. The ureters are then divided at their entrance into the bladder. Small polyethylene tubes are placed temporarily in the ureters in order to divert urine during removal of the bladder. The bladder is removed, severing it at the level of the prostatic urethra in male animals but leaving the gland intact; in females, the urethra is transected just below the neck of the bladder.

An isolated segment of ileum is obtained by transecting bowel and its mesentery to obtain a 12 inch loop, and then restoring continuity by end-to-end anastomosis. (Fig. 1, A.) After closure, this segment of bowel is irrigated with normal saline solution followed by the instillation of 20 cc. of 1 per cent neomycin. Both ends are then closed using a fine continuous catgut suture for the mucosa and reinforcing this by inverting mattress sutures of cotton.

Because of disappointing experiences with various types of tunneling operations, we have come to regard the technic of implantation of

LIBRARY
BOSTON UNIVERSITY
SCHOOL OF MEDICINE

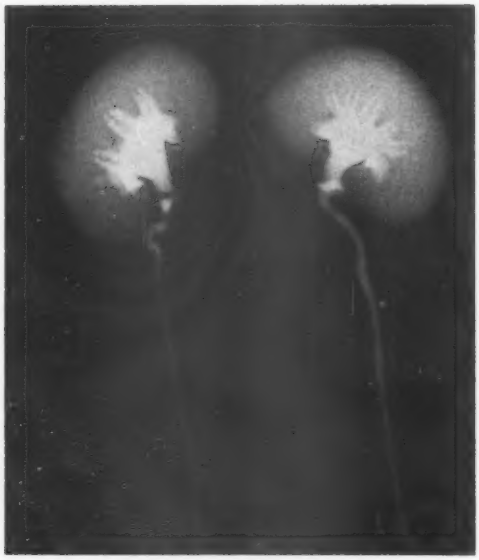


FIG. 2. Postmortem retrograde pyelograms.

the ureters as an exceedingly important part of the operation. Two 3 mm. stab wounds are made through the full thickness of the ileum and 1 cm. from the antemesenteric border. These incisions are placed 4 to 6 cm. on either side of the mid-point of the isolated segment. A 1.5 cm. incision is made in the long axis of the ileum on its antemesenteric border. This opening in the exact center of the loop will be used for the anastomosis of the urethra. (Fig. 1, B.) The polyethylene tube previously placed in the left ureter is brought up to the ileal loop, and threaded through the left-hand stab wound and out through the larger antemesenteric incision. Four sutures of fine catgut on an Atraumatic® needle are placed at equal distances around the circumference of the ureter, being passed from without inward through the ureter and then from within outward through the bowel. The polyethylene tubing serves as a splint, and care is taken to include not more than 2 mm. of tissue as the needle passes through ureter and bowel. These sutures are tied on the outside. Angulation of the ureter is then encouraged by anchoring it to the serosa of the bowel in a plane perpendicular to the axis of the latter. This is accomplished by placing superficial sutures of No. 6-0 silk on an Atraumatic needle along both sides of the ureter for a distance of 2 to 3 cm. A similar technic is followed for the right ureteral anastomosis. (Fig. 1, B.) The polyethylene tubes protruding from the central incision are threaded through the urethra and brought out the external meatus. They are removed after twenty-four hours.

The urethra is anastomosed to the bowel with a two-layer technic. Just prior to completion of the anastomosis, a Foley catheter is placed down the urethra into the isolated segment and inflated with 2 cc. of water.

Postoperative Care. After operation the dogs are wrapped in warm blankets and placed in recovery cages in a temperature-controlled room. They receive 200 to 1,000 cc. of 5 per cent glucose in Ringer's lactate during surgery, and usually 1,000 cc. of 5 per cent glucose in distilled water during the first twenty-four hours after operation. These dogs are given 300,000 units of procaine penicillin and 0.5 gm. of streptomycin. They are allowed to drink milk or water as desired after the first day, and resume their regular diet on the fourth day. The polyethylene tubes are removed from the ureters after twenty-four hours and the urethral catheter after one week.

Technic of the Two-Stage Procedure. The two-stage procedure is essentially the same with these exceptions: (1) Instead of closing the distal end of the ileal segment, it is brought out as an ileostomy. (2) The polyethylene tubes are brought out through the ileostomy instead of through the urethra and removed at the end of the procedure. (3) No ureteral catheter is used to splint the anastomosis with the ileal segment. The second stage of the two-stage procedure consists of closure of the ileostomy extraperitoneally, thus completing the construction of the new bladder three to six weeks after the first stage. (Fig. 1, C.)

Results: One-Stage Procedure. Five animals had various tunneling anastomoses and died of uremia following hydronephrosis due to stricture at the ureterosegment anastomosis. One received an overdose of sodium Pentothal during surgery; in another a prostatic abscess developed which perforated into the peritoneal cavity causing peritonitis and death; the last fatality was due to an intussusception of the proximal portion of the isolated loop, leading to perforation, peritonitis and death.

Of the three dogs surviving the one-stage procedure, all had direct ureteral anastomosis as described in the surgical procedure.

TABLE 1
PRE- AND POSTOPERATIVE CHEMISTRIES*

Time	No. of Dogs	Sodium	Potassium	Blood Urea Nitrogen	Carbon Dioxide	Chloride	Phosphorus	Creatinine
Dogs Surviving One-Stage Procedure								
Preoperatively	3	153	4.4	17	23	113	4.3	2.2
1 wk.	3	150	4.4	46	21	111	5.3	1.7
2 wk.	3	148	4.7	35	20	103	5.3	1.7
1 mo.	3	150	4.3	29	24	111	6.7	1.3
2 mo.	3	150	4.3	27	23	110	6.9	.9
3 mo.	2	149	4.4	31	24	111	6.1	1.7
Dogs Surviving Two-Stage Procedure								
Preoperatively	5	146	4.8	21	20	109	5.2	1.6
1 wk.	5	148	4.9	37	19	111	6	2.8
2 wk.	5	155	5.0	38	21	110	5.2	2.1
1 mo.	5	146	4.9	37	22	109	6.2	1.9
Ileostomy closed:								
1 wk.	5	144	4.9	30	23	113	6.4	1.6
2 wk.	5	150	4.8	30	23	111	3.5	1.1
1 mo.	5	148	4.8	27	24	108	5.4	1.5
2 mo.	5	149	4.9	29	25	109	5.3	1.3
3 mo.	2	151	5.1	31	24	109	5.3	1.4
7 mo.	1	150	4.8	26	22	109	5.0	1.2

* Deviation from the above averages are very little, if any, in individual animals.

Functional Results: One-Stage Procedure. By one week following the operation, voiding occurred every hour. No residual urine was obtained. No reflux could be demonstrated. Postmortem retrograde pyelograms following sacrifice revealed little to no dilation. (Fig. 2.) Excretory urograms were of little value because of the rapid emptying of dye into the bladder before concentration in the upper urinary tract was possible. However, of the three surviving dogs, excellent cystograms following excretory urograms were obtained in less than five minutes. Chemistries remained within normal limits. (Table 1.) The discharge of mucus was enormous. Repeated irrigations to prevent obstruction were required. Gross pathological examination following sacrifice revealed an abundance of mucus in the substitute bladder but no demonstrable dilation of the upper tract and ileal segment.

Results: Two-Stage Procedure. Among the nine animals undergoing the two-stage procedure, four deaths occurred, the causes of which were (1) acute pyelonephritis following repeated dilations of a stenosing external urethrotomy, resulting in death on the ninety-eighth postoperative day; (2) overdose of sodium pentothal at surgery; (3) trauma following a dog fight on the eighty-fifth postoperative day; and (4) a prostatic abscess with perforation, peritonitis and death on the seventy-seventh postoperative day.

Functional Results: Two-Stage Procedure. Prior to closure of the ileostomy, progressive stenosis of the ileostomy and simultaneous gradually increasing continent voiding per urethra were noted. A marked diminution in the output of mucus occurred from the third to the sixth week after completion of the first stage of the operation, whereupon the ileostomy was closed. Following closure very little subsequent mucus was formed. Immediate continent voiding every one to two hours was noted. Residual urine was not present.

Combined Results: Eight Dogs, One- and Two-Stage Procedures. Cystometrograms on three animals revealed bladder capacities from 100 to 120 cc. with forceful kick-off at these volumes. (Fig. 3.) Immediately following ureteral anastomosis there was sometimes an initial rise in

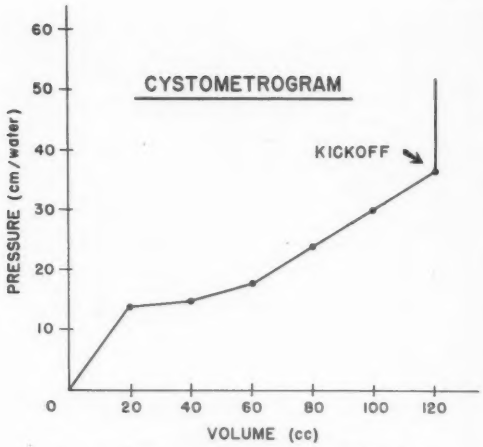


FIG. 3. Cystometrogram of a surviving dog.

blood urea nitrogen which eventually stabilized within normal limits. Cystograms revealed evidence of reflux on one side only in two dogs. (Fig. 4.) Immediate postmortem retrograde pyelograms revealed little if any dilation of the upper urinary tract. (Fig. 2.) There was no variation in the blood chemistry at the time of closure of the ileostomies. The only changes observed were those following ureteral anastomosis. (Table 1.)

PATHOLOGY (TABLE II)

Gross Examination, One-Stage Procedure. There was no evidence of dilation of the ileum or the upper urinary tract. However, an abundance of mucus was noted within the lumen of the segment.

Gross Examination, Two-Stage Procedure. There was no evidence of dilation of either the segment or upper urinary tract, and little to no debris could be found in the substitute bladder. The mucosa appeared thin and pale grey to pink in color.

Microscopic Patbology. All ureters in both one- and two-stage procedures were normal and there was no stenosis.

A total of six kidneys studied from survivors of the one-stage procedure revealed that two had moderate infiltration of the interstitial spaces with mononuclear cells; one had polynuclear cell infiltration and another had congestion of vascular components.

Eight kidneys from survivors of the two-stage procedure were studied, and two were found to have moderate infiltration of the interstitial spaces with mononuclear cells; another, slight necrosis of the papillae; and the last, fibrinoid necrosis of an occasional glomerulus. The remaining kidneys were normal.

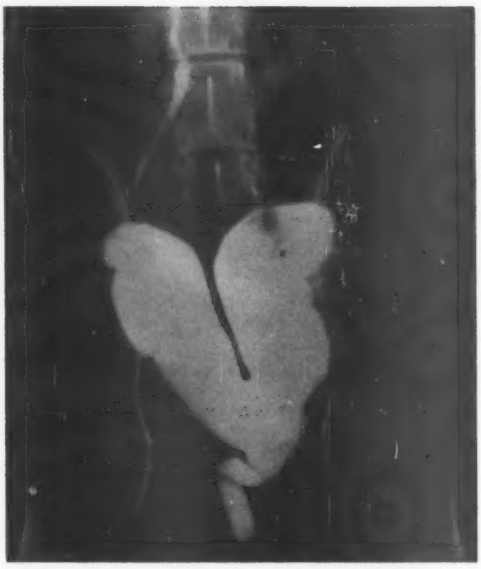


FIG. 4. Cystogram showing reflux up one ureter.

All substitute bladders appeared to be undergoing a pathological change in a uniform manner. (Fig. 5.) Pseudomembranous-like necrosis

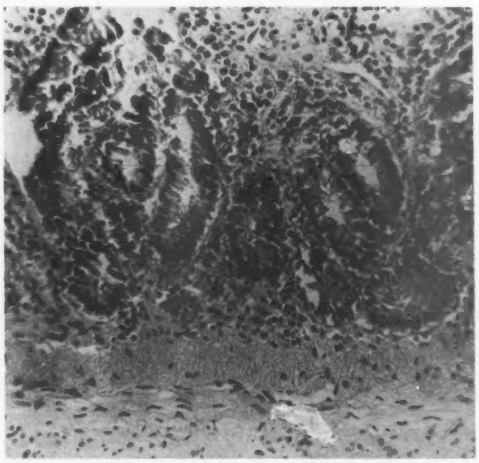


FIG. 5. Section of artificial bladder showing intact basement membrane and pseudomembranous necrosis of the mucosa.

TABLE II

PATHOLOGICAL CHANGES OCCURRING IN THE URETERS, KIDNEY AND SUBSTITUTE BLADDER OF SURVIVING ANIMALS

Dog No.	Right Ureter	Left Ureter	Right Kidney	Left Kidney	New Bladder
			Histological Studies: One-Stage Operation		
5	Normal	Normal	Occasional infiltration of mononuclear and polynuclear cells into interstitial spaces; slight dilation of tubules	Occasional infiltration of mononuclear and polynuclear cells into interstitial spaces	Superficial necrosis of mucosa; numerical decrease in number of glands; basement membrane intact; no inflammation
6	Normal	Normal	Normal	Slight congestion of vascular components; no inflammation	Same changes as above
7	Normal	Normal	Normal	Normal	Same changes as above, only much less severe
			Histological Studies: Two-Stage Operation		
1	Normal	Normal	Moderate infiltration of mononuclear cells in interstitial spaces; slight fibrinoid necrosis of occasional glomeruli	Moderate infiltration of mononuclear cells in interstitial spaces; very slight necrosis of some papilli	Necrosis of mucosa; decrease in number of glands; intact basement membrane; no inflammation
2			Not sacrificed, to be used in long term study		
3	Normal	Normal	Normal	Normal	Same as (1)
4	Normal	Normal	Normal	Normal	Same as (1) and (3)
8	Normal	Normal	Normal	Normal	Same as (1), (3) and (4)

with actual numerical diminution of glands was apparent. The basement membranes remained intact, and no submucosal inflammatory changes were demonstrable. The muscular layers were normal.

TWO-STAGE PROCEDURE IN MAN

On the basis of the preceding studies we felt justified in operating upon a thirty-eight year old white man who for ten years had progressive leukoplakia of the bladder with scattered islands of cystitis glandularis and a bladder capacity of approximately 30 to 40 cc. At the time of writing it is nine months after the two-stage operation. Mucous secretion is no problem. His blood chemistry is normal. Pyelograms show minimal to no dilation, and cystograms show some reflux up the right but not the left ureter. His bladder capacity is 4 ounces and no residual urine is present. There is perfect continence during the day but bed-wetting occurs once nightly. The details and long term study of this case will be reported at a later date.

COMMENTS AND CONCLUSIONS

Realizing that these studies are short term ones and as yet incomplete, one of the eight surviving dogs and four animals freshly prepared by the two-stage procedure are being subjected to studies of long term survival, the results of which will be released at a later date.

It is our belief that one of the most important technical aspects of this operation is the type of ureteral anastomosis employed. It is a direct end-to-side method with the ureter wrapped around and attached to the bowel wall along its undersurface for some distance. This creates a sphincteric action in that as the segment expands with urine the ureter flattens, causing temporary occlusion so that reflux does not easily occur, and with contraction the long attachment of the ureter to the bowel surface tends to bend the ureter and again to prevent reflux.

Another important aspect of the study is the apparent diminution of mucous secretion after urine has bathed the mucous membrane of the bowel for a period of time. The decreased

mucus might be explained on the basis of superficial pseudomembranous necrosis and actual decrease in secreting tissue, as noted in the histological study. An explanation for the necrosis cannot be offered except that the usual secretions bathing ileal mucosa are alkaline, and a shift of pH may be a factor.

As pointed out, there is no essential difference in the chemistries after completion of the first and second stages of the two-stage procedure, nor is there a difference in these chemistries and those obtained after the one-stage operation. The only changes which occur are those after the ureteral anastomosis, whether it be a one- or two-stage procedure. This is taken as evidence that there is little or no differential reabsorption between chlorides and sodium from the ileal segment. It further implies that changes which do occur are secondary to ureteral implants into the segment.

The fact that these animals have voluntary control has caused us to postulate that sensory fibers in the urethra are stimulated as the intraluminal pressure of the segment rises. Impulses are then carried to the brain on sensory pathways where motor centers are stimulated, causing impulses to be carried down motor pathways to the external sphincter. This motor stimulus causes the sphincter to open, allowing the segment to empty by virtue of the fact that it is a smooth muscle, hollow viscus which when stretched will normally contract.

The pathological changes in the segment are interesting to speculate upon. Apparently the necrosis and decrease in the number of glands is of clinical benefit, in that there is a corresponding decrease in mucous secretion. The basement membrane remains intact in a mucous membrane whose environment has been completely changed. This leads one to wonder if after a long period of time the normal ileal mucosa might not disappear and be replaced by transitional epithelium extending upward from the urethra and downward from the ureters on already viable intact basement membrane.

SUMMARY

Twenty dogs were operated upon utilizing one- and two-stage procedures to create an artificial bladder from a loop of ileum, and the technic is described. Pre- and postoperative chemical studies, physiological studies of the new bladder and studies of the pathological changes are described and compared. The two-stage procedure appears more feasible because of the mucus factor. The optimal time for closure of the ileostomy in the two-stage procedure appears to be when mucous secretion has diminished, chemistries are stabilized and dilation of the upper tract is minimal. All tunneling anastomoses of the ureter produced stricture with subsequent hydronephrosis, uremia and death. A brief description of a man subjected to the two-stage procedure, along with the early results, is submitted. Late follow-up studies on five dogs prepared by the two-stage procedure are being made and will be presented at a later date.

Acknowledgment: Sincere gratitude is extended to Dr. John Paul North, Chief, Surgical Service, V. A. Hospital, Dallas, Texas, for his critical reviews and advice; to Drs. Ralph Smith and Percy Duff, Urology Service, V. A. Hospital, Dallas, Texas, for their encouragement and helpful suggestions; to Drs. Ben Wilson and Jerry Stirman for their critical analyses of the subject; to Dr. Dode Hanke, Mr. I. Noguera, Dr. Thomas Capers and Miss Jeanne Palmer, and to the U. S. Public Health Service grant, without which this experimental study would have been impossible.

REFERENCES

1. Bricker, E. M. Bladder substitution after pelvic evisceration. *S. Clin. North America*, 30: 1511–1521, 1950.
2. Heitz-Boyer, M. and Hovelacque, A. Creation d'une nouvelle vessie et d'un nouvel uretre. *J. d'urol.*, 1: 237–258, 1912.
3. Pyrah, L. N. The use of ileum in urology. *Brit. J. Urol.*, 28: 363–370, 1956.
4. Rubin, S. W. The formation of an artificial urinary bladder with perfect continence; an experimental study. *Am. J. Urol.*, 60: 874–901, 1948.
5. Shoemaker, W. and Grotzinger, P. Total bladder substitution using reversed seromuscular grafts. *S. Forum*, 6: 619–623, 1955.
6. Tizzoni and Foggi, A. Die Weiderherstellung der Harnblase; Experimentelle Untersuchengen. *Centralbl. f. Chir.*, 15: 921–924, 1888.

Comparative Study of Bile Drainage in Dog and Man

T. OGAWA, M.D., N. C. JEFFERSON, M.D. AND H. NECHELES, M.D., PH.D., *Chicago, Illinois*

From the Department of Gastro-Intestinal Research, Medical Research Institute of Michael Reese Hospital, Chicago, Illinois. This study was supported by the Jeanne R. and Jerome Abeles Foundation. The Department is supported in part by the Michael Reese Research Foundation.

INCREASING numbers of drastic surgical approaches to the liver and biliary tract have been proposed in recent years (e.g., partial hepatectomy, Longmire operation). Dogs have been the most readily available and useful material for experimental study in this field. In our attempts to establish methods for bile drainage in the treatment of biliary atresia, we found no detailed descriptions of the anatomy of the biliary tract of the dog [2,5].

In the present study we have observed certain characteristics of the anatomy of the bile ducts in the dog, as compared with that in man. If these differences are not taken into consideration, results of certain experiments on the dog are misleading when applied to hepatic surgery in man.

METHODS

Experiments with Excised Liver. Twenty-six adult mongrel dogs of both sexes were sacrificed with intravenous pentobarbital sodium, and liver and extrahepatic bile ducts were excised *en masse*. The liver was squeezed gently in order to remove as much blood and bile as possible. The cystic duct was ligated, and the common bile duct or one of the main hepatic ducts was intubated with a plastic tube through which red lead suspension or colored resin solution was injected. In a few specimens, each main hepatic duct was injected with resin solution of a different color. In case of injection with red lead, a roentgenogram of the liver was taken, followed by direct observation by carefully scraping off the liver tissue for exposure of the ducts. A number of livers injected with resin solution were digested in concentrated hydrochloric acid, leaving a hardened resin cast of the biliary tract. In other livers injected with resin, parenchymal tissue was scraped off the hardened resin cast and each hepatic duct was traced to the periphery.

Fresh livers of two human adults and three fetuses were studied. The former were obtained from autopsies performed soon after the death of patients with no involvement of the liver, and the latter were taken from stillborn fetuses seven to nine months of age. The specimens were examined with the procedures used on the dogs' livers.

Chronic Experiments in Dogs. With the animal under pentobarbital sodium anesthesia and maintaining aseptic conditions, the gallbladder was extirpated, and two of the three main hepatic ducts were cut between ligatures; the right and middle hepatic ducts were sectioned in four dogs, the left and middle ones in one, and the right and left ones in five dogs. Postoperatively, penicillin and streptomycin were administered intramuscularly for a few days, and intravenous fluids were given on the first postoperative day if necessary; serum bilirubin was determined at intervals. The dogs were killed with intravenous pentobarbital sodium thirty-one to 246 days after operation. The liver was excised and examined for macroscopic changes; red lead was injected through the intact hepatic duct in order to determine the extent of the functioning lobes or areas. Sections of liver tissue were stained with hematoxylin-eosin.

RESULTS

Based on the presence of deep fissures, the liver of the dog is usually described as consisting of five or six lobes. However, on the basis of our observations on the distribution of the bile

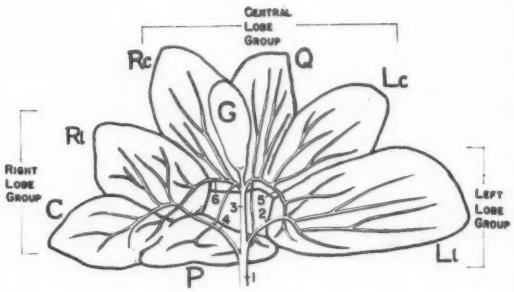


FIG. 1. "Standard pattern" of bile duct distribution in dog's liver. Ll, left lateral lobe. Lc, left central lobe. Q, quadrate lobe (often considered as part of right central lobe). Rc, right central lobe. Rl, right lateral lobe. C, caudate lobe. P, papillary lobe (papillary process of caudate lobe). (1) Common bile duct. (2) Left hepatic duct. (3) Central hepatic duct. (4) Right hepatic duct. (5) Left communicating duct. (6) Right communicating duct. G, gallbladder.

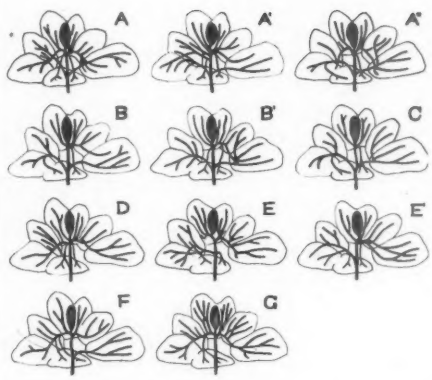


FIG. 2. Variations from standard pattern in bile duct distribution (see text).

ducts, we propose three main groups of lobes—a left, a central and a right group. (Fig. 1.) According to the present terminology, the left group comprises the left lateral and occasionally the left central lobe; the central group comprises the left central lobe, which sometimes is subdivided into the quadrate and the right central lobe, and the left central lobe; the right group comprises the right lateral lobe and the body of the caudate lobe. We propose not to include the papillary process of the caudate lobe in any of the three groups because it is a variable and apparently accessory structure; for shortness we propose to call it "papillary lobe." The deep fissures mentioned previously do not separate all lobes completely but there is more or less parenchymal connection between adjacent lobes near the hilum, except between the right lateral and central lobes and the left lateral and central lobes where usually no parenchymal connection is seen.

The distribution of the bile ducts shows so many variations that hardly any two specimens have exactly the same pattern. However, a standard pattern of distribution can be established from which variations can be derived [2]. In the standard pattern proposed (Fig. 1), the common bile duct is formed by the confluence of three main branches: the left, central and right hepatic ducts, the last one usually joining the trunk most distally. The gallbladder is situated in a recess on the undersurface of the right central and quadrate lobes, and the cystic duct opens into the middle hepatic duct or into one of its two main branches. The left and right hepatic ducts drain bile from the left and right lobe groups, respectively. The central hepatic duct, in addition to distributing itself to the central lobe group, receives in the hilum a small duct from the left lobe group and another from the right lobe group, the left and right communicating ducts, respectively. The papillary lobe (the small accessory lobe) receives extrahepatic ductules from branches of the central hepatic duct.

The variations from the standard pattern observed are shown in Figure 2. Although they were numerous, they may be classified in the following seven principal categories: (1) three hepatic and two communicating ducts (standard pattern or small variations, A, A′, A″); (2) absence of the right communicating duct (B, B′); (3) absence of the right and left communicating ducts (C); (4) absence of the left hepatic duct (D); (5) absence of the left hepatic and the right communicating ducts (E, E′); (6) absence of the right hepatic and the left communicating ducts (F); and (7) absence of the left and right hepatic ducts (G).

The distribution of the bile ducts in the papillary lobe showed numerous variations (Fig. 2; note differences among A, B, D, E, E′ and F) but since this lobe and its ducts are small and apparently unimportant, these varia-

TABLE I
LIGATION OF HEPATIC DUCTS IN THE DOG

Dog No.	Operation	Sacrificed (days postoperatively)	Findings
A-1	Ligation of right and central hepatic ducts, cholecystectomy	31	Dilatation of ducts, white bile in right and central lobe groups
A-2	Same as above	83	Moderate atrophy of right and central lobe groups; moderate hypertrophy of right lobe groups (two lobes)
A-3	Same as above	178	Marked hypertrophy of left lobe and marked atrophy of other lobes
A-4	Same as above	21 (Died)	Bile peritonitis, subphrenic abscesses containing bile
B-1	Ligation of left and central hepatic ducts; cholecystectomy	122	Considerable atrophy of central and left lobe groups; hypertrophy of right lobe group
C-1	Ligation of left and right hepatic ducts; cholecystectomy*	111	Mild atrophy of left and right lobe groups; mild hypertrophy of central lobe group
C-2	Same as above	139	Mild atrophy of left and right lobe groups; mild hypertrophy of central lobe group and papillary lobe
C-3	Same as above*	252	Marked hypertrophy of central lobe group and papillary lobe; marked atrophy of left and right lobe groups
C-4	Ligation of left and right hepatic ducts (gallbladder intact)*	220	Marked hypertrophy of central lobe group and papillary lobe; marked atrophy of left and right lobe groups
C-5	Incomplete obstruction of left and right hepatic ducts; cholecystectomy	201	Ligated ducts had recannulated spontaneously, liver lobes normal

* Incomplete obstruction preceded complete ligation by one week (postoperative days counted from second operation).

tions are not considered in the aforementioned classifications.

The small number of our experiments does not allow a statistical study on the incidence of so many variations. However, the distribution of the bile ducts mentioned in (1) was observed in the majority of cases, although the two communicating bile ducts were often of minute size and drained only small portions of the lateral lobe groups.

When one lobe of the liver contains two major intrahepatic ducts (e.g., the left lateral lobe contains the left hepatic and the left communicating ducts) it may be possible that if sizable anastomoses were present between those two systems, a dye injected into one duct would flow into the other one. However, this has not been observed, even when dilute Janus green solution was used. In the livers in which the bile ducts had been injected with resin solution and the parenchyma digested adequately, even finer bile ducts, i.e., bile ductules, were well filled; they surrounded an interlobular bile duct like a plexus, forming a portal unit. Communications between each portal unit by anastomosis of bile ductules seemed to be very poor, if any.

Distribution of bile ducts in the human liver is also somewhat variable, as described by Healy and Schroy [3] and Elias and Petty [1], but much less than in the dog's liver. In man the bile ducts branch mainly intrahepatically, whereas they must branch extrahepatically in the dog. The intrahepatic bile ducts in the human fetal specimen are so minute that only main ducts could be filled with red lead or resin solution; no anastomoses were found between intrahepatic bile ducts of up to the third order.

The results of the chronic experiments on dogs are summarized in Table 1. Serum bilirubin concentration usually rose slightly (within normal limits) one to two weeks postoperatively and then decreased. (Fig. 3.) Some of the animals gradually lost weight during the first one to two months after operation and then regained it.

The lobe groups with ligated hepatic ducts

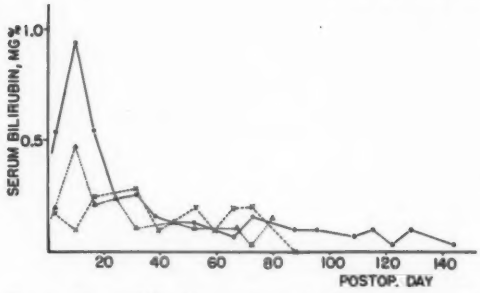


FIG. 3. Serum bilirubin concentration after ligation of hepatic ducts (see Table 1). --------▲--------, dog A-2; ——●——, dog A-3; --------×--------, dog B-1.

eventually developed marked atrophy, and the remaining lobe group with intact hepatic ducts showed compensatory hypertrophy of a degree that the preoperative liver mass did not change and its function remained more or less normal. (Fig. 4.) Atrophy of lobes amounted to one-fifth or even less of their original sizes; they were pale in color and firm and elastic in consistency, with smooth and glossy surfaces. Hypertrophied lobes were red, soft and friable, and their surfaces were rough and dull. White bile was usually seen in the dilated bile ducts of the atrophied lobes.

In the development of atrophy and hypertrophy of the lobes of the liver, a time factor became apparent. When the right and central hepatic ducts or the left and central hepatic ducts had been ligated, marked atrophy and hypertrophy developed within approximately three to four months, whereas when the right and left hepatic ducts had been ligated a longer period of time elapsed before a similar degree of change occurred. This may be attributed to the presence of patent communicating ducts in the latter group, which drained part of the lobe.

Changes of the papillary lobe after ligation of the hepatic ducts were inconsistent. In parallel experiments, atrophy or hypertrophy of this lobe occurred, depending upon the numerous, irregular variations in the distribution of its bile ducts.

Histologic Findings. The hypertrophied lobes appeared to have increased numbers of polygonal cells, but no increase in the size of the individual cell was noted. The atrophied lobes showed distinct bile stasis, i.e., dilated bile ducts, bile lakes, bile thrombi and pigment in liver cells. The lobules were surrounded by fibrotic tissue which compressed them, similar in appearance to the cirrhotic liver in man.

COMMENTS

The human liver is divided into two distinct lobes, left and right, and an accessory lobe, the caudate lobe. The left lobe is drained by the left and the right lobe by the right hepatic duct. The gallbladder usually opens into the common hepatic duct, forming the common bile duct. If one compares the liver of the dog with that of man, the middle hepatic duct may be considered as the common bile duct, the left and right hepatic ducts as aberrant branches, and the two main branches of the middle hepatic duct as the left and right hepatic ducts. Thus, for the sake of comparison, the dog's liver may be divided into two lobe groups, with the dividing line situated between the quadrate lobe and the right central lobe. The fact that the middle hepatic duct is the largest of all and receives the cystic duct can be considered to support this partition of the dog's liver and, from the standpoint of evolution, it may be more logical than the division into three lobe groups proposed previously herein. We believe however, that the latter classification is more practical and may be of considerable advantage to the investigator in experimental surgery. In either classification, the caudate lobe of the human liver and the corresponding papillary lobe (the papillary process of the caudate lobe) of the dog's liver have not been included, because both are considered to be accessory structures of little importance.

Much of our experimental work was devoted to attempts to produce collateral drainage between major intrahepatic bile ducts in one or in adjacent connected lobes. We believed that the "law" of formation of new blood capillaries from regions of increased capillary pressure or into regions with low capillary pressure [6] might apply to bile capillaries; if bile pressure were high in a segment of the liver, new capillaries might form and connect with capillaries in adjacent ducts interconnecting different bile drainage areas, or existing ducts might enlarge sufficiently to permit the flow of obstructed bile into another major duct. Although the left and the right lobe group contain two major bile duct systems, in the majority of cases the communicating duct is usually of minute size, draining only a small portion of one or two lobes. Furthermore, there appears to be no

or very little connection between the ductules of the communicating duct and those of the left or right hepatic duct, and when the left or right hepatic duct is obstructed, drainage through the communicating duct is not adequate to prevent atrophy but its development may be delayed.

In chronic experiments on three dogs, incomplete ligation of the left and right hepatic ducts was performed one week prior to complete ligation (C-1, C-3, C-4,) in an attempt to produce sizable anastomoses between the duct systems by gradually increasing intraductal pressure, but no positive results were obtained. We were surprised at how fast the liver cells stop secreting bile after complete occlusion of a major bile duct, and how fast white bile appears and green bile disappears in the lumen of the ducts. Whether this phenomenon can explain bile stasis or lack of formation of anastomotic bile channels remains to be seen.

The major bile ducts were of such small size in the injection specimens of fetal liver that we doubt the feasibility of the Longmire operation [4] in the very young infant with agenesis of extrahepatic bile ducts.

The results of our experiments with obstruction of major bile ducts in the adult dog indicate that slowly developing obstruction leads to considerable dilatation of major bile ducts, which facilitates anastomotic operations or the Longmire procedure. This experience is paralleled by similar experiences in patients.

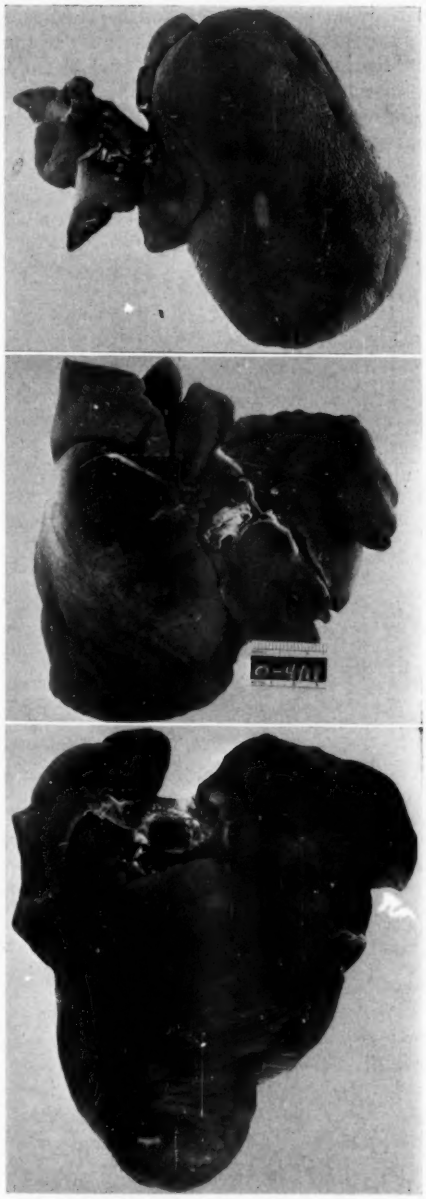


FIG. 4. Hypertrophy and atrophy of lobes of dog's liver after ligation of hepatic ducts (see Table 1). A, hypertrophy of left lobe group, atrophy of the other lobes (dog A-3). B, hypertrophy of right lobe group, atrophy of the other lobes (dog B-1). C, hypertrophy of central lobe group, atrophy of the other lobes (dog C-4).

SUMMARY

The biliary drainage systems of the mongrel dog and fetal and adult human livers were investigated. Livers were injected with red lead suspension and roentgenograms were taken; other specimens were injected with colored resin, and the bile ducts were examined by scraping off the parenchyma or after digestion of the parenchyma. In chronic experiments on dogs, major hepatic ducts were ligated and the livers were examined after varying periods of time. Neither in the liver of normal human beings nor dogs were intrahepatic connections found between major bile ducts. Ligation of one or of several hepatic ducts was not followed by evidence of formation of new or dilatation of pre-existing channels between bile duct territories. The distribution of the major bile ducts in the dog is variable, and results obtained by ligation of

certain ducts may lead to erroneous conclusions and may not be applicable to surgery in man. Bile ducts in the fetal liver are minute and, in the absence of extrahepatic bile ducts, the Longmire procedure for biliary drainage does not appear to be practicable.

REFERENCES

1. Elias, H. and Petty, D. Gross anatomy of the blood vessels and ducts within the human liver. *Am. J. Anat.*, 90: 59, 1952.
2. Ellenberger, W. and Baum, H. Anatomie des Hundes, pp. 305–310. Berlin, 1891. Paul Parey.
3. Healy, J. E., Jr. and Schroy, P. C. Anatomy of the biliary ducts within the human liver. *Arch. Surg.*, 66: 599, 1953.
4. Longmire, W. P., Jr. and Sanford, M. C. Intrahepatic cholangiojejunostomy for biliary obstruction—further studies. *Ann. Surg.*, 130: 455, 1949.
5. Rex, H. Beiträge zur Morphologie der Säugerleber. *Morphol. Jahrb.*, 14: 517, 1888.
6. Thoma, R. Über die Strömung des Blutes in der Gefässbahn und die Spannung der Gefässwand. *Beitr. z. path. Anat. u.z. allg. Path.*, 66: 377, 1920.

The rate of admission to general hospitals in this country has increased by almost 80 per cent in the last twenty years, from fifty-six to ninety-nine admissions per 1,000 population. As a result, these hospitals have become increasingly important in the total health picture. The average patient in a general hospital today spends 8.6 days there, a decline of about one-third from the 12.5 average of twenty years ago.

A Cannula for Biopsy of the Brain

ROGER M. MORRELL, M.D., *Montreal, Canada*

From the U. S. Public Health Service Hospital, Staten Island, New York.

THE instrument described in this report was designed to obtain specimens of brain, adequate for frozen or permanent section, with a minimum of bleeding.

DESCRIPTION

The instrument is shown in Figures 1A and B. A central hollow shaft, containing a solid obturator, is fitted externally with a sliding screw-tightened support that can be set on the scalp for use with a twist drill opening,

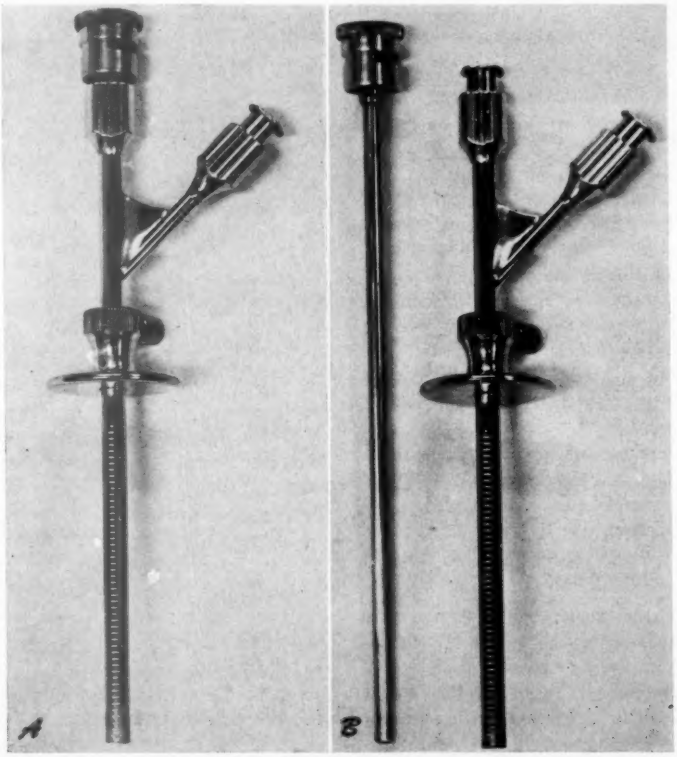


FIG. 1. A, cannula for biopsy of the brain with obturator in place. B, cannula for biopsy of the brain with obturator removed.

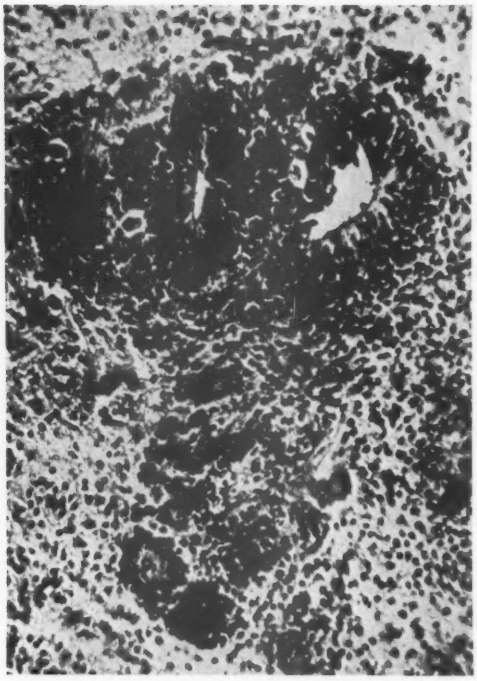


FIG. 2. Case I. Neuroblastoma, right parietal lobe. Hematoxylin and eosin stain.

on the edge of a burr hole, or the intact dural surface, through which a small incision is made to accommodate the circular tip of the cannula. The lower half of the cannula is calibrated in millimeters to facilitate accurate placement in depth. The upper end is supplied with a Luer-lok attachment for the obturator or a syringe. The hollow side arm communicates with the lumen of the cannula and has a Luer-lok attachment.

The cutting surface of the instrument is unique in that the sharpened edge is on the inner aspect of the end of the cannula occupying its total circumference.

APPLICATION

With the obturator in place, no tissue is cut. With the obturator removed, tissue is cut by advancing the cannula and twisting it between the thumb and forefinger. The diameter of the block is 3 mm., and the length can be controlled by observing the calibration of the cannula. The funnel-shaped interior location of the cutting edge allows vessels to be pushed aside by the smooth but dull outer aspect of the tip of the cannula.

The cutting edge, viewed on end, is 0.9 mm. in thickness, representing the width of the wall of the cannula. The cut block remains snugly held in the lumen, and is removed by suction with a hypodermic syringe applied to the Luer-lok attachment of the cannula.

HEMOSTASIS

Before suction is applied, the upper sliding attachment is secured for stability and the maintenance of hemostasis, which can be attained in one of three ways: (1) normal saline solution introduced through the side arm exerts sufficient hydrostatic pressure to counteract slight oozing from the bed used for biopsy; (2) the introduction of liquid fibrin results in a firm clot at the case of the cannula at the side arm; and (3) brisker bleeding is controlled by application of low coagulating current to the external end of the cannula which is insulated to the tip. Bleeding of this magnitude has not been encountered in clinical trials with the instrument.

RESULTS

Photomicrographs of specimens of tissue are seen in Figures 2 through 6. Tissue was obtained in one patient (Case III) through a twist drill hole, and in the others at operation using the cannula.

Of the patients whose tissue was prepared and photographed, minor bleeding was encountered in two. This was evidenced by the appearance of blood in the side arm at the end of the cutting operation. In both patients the administration of 2 ml. of fibrin solution established hemostasis, following which the cannula was gently withdrawn without disturbing the clot. Studies were performed in normal cats at craniotomy with dermal biopsy punches and needles, and with the Vim-Silverman needle and its modification, the Vim auger needle [1]. These failed to produce specimens of the clarity of those obtained with the cannula herein described.

In addition, in animals it was noted that other instruments used for biopsy, particularly those with external cutting edges, produced more bleeding than the cannula.

In all the patients and animals having neurosurgical procedures, adrenochrome semi-

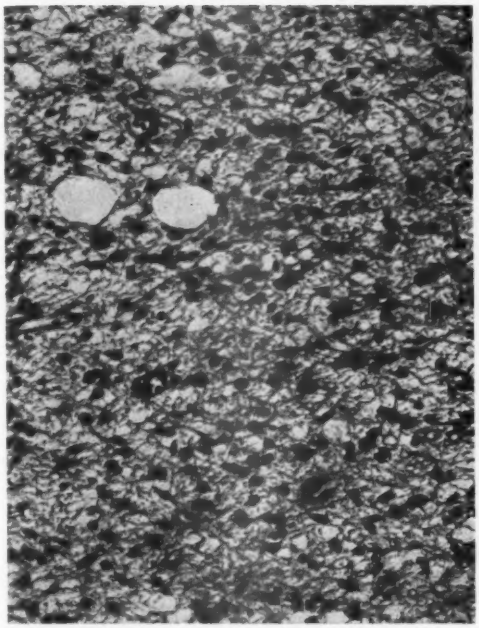


FIG. 3. Case II. Right anterolateral astrocytoma. Hematoxylin and eosin stain.

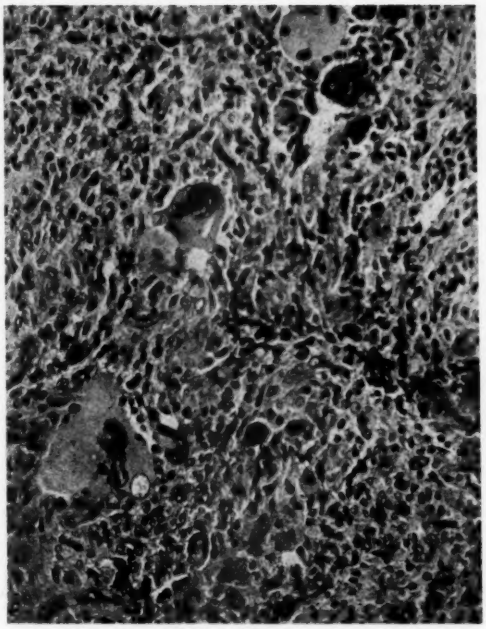


FIG. 4. Case III. Glioblastoma multiforme, left frontal lobe. Hematoxylin and eosin stain.

carbazone had been administered prior to operation. A separate report on the effectiveness of this systemic hemostatic agent will be made.

CASE REPORTS

CASE I. (Fig. 2.) A four year old girl presented with a five-month history of headaches, nausea and vomiting. There was swelling in the right occipitoparietal region. There was bilateral papilledema but no localizing signs. X-ray films of the skull showed widening of the cranial sutures and some calcified shadows in the right posterior parietal region. At operation an erosive, infiltrating tumor was found, which was removed with a portion of the overlying bone. Examination of the biopsy specimen revealed tumor tissue composed of cells having the appearance of neuroblasts.

CASE II. (Fig. 3.) A forty-six year old white man presented with fainting, left hemiparesis, papilledema and pineal shift to the left. Ventriculogram revealed a neoplasm in the right anteroparietal area. Frozen section showed a cyst and an astrocytoma. The tumor was composed of adult fibrillary and protoplasmic astrocytes, with small, round, darkly-staining nuclei embedded in a feltwork of neuroglial fibrillae.

CASE III. (Fig. 4.) A fifty-two year old white woman presented with progressive nominal aphasia and intermittent disturbances of gait. At operation a glioblastoma multiforme of the left frontal lobe was encountered. A marked variety of cell types and shapes was seen: glial cells, unidentifiable cells and debris, multinucleated giant cells, many mitotic figures and areas of necrosis. Numerous thin-walled vessels were shown, made up of intima surrounded by degenerative connective tissue. Palisades of cells were seen around certain vessels, and macrophages appeared in necrotic areas partially infiltrated with fat or hyaline material.

CASE IV. (Fig. 5.) A thirty-seven year old white man had had a primary lesion in the axilla removed fourteen months previously. Cerebral metastases were multiple and included leptomeningeal implantation. The brain lesions were surrounded by edema and cerebral softening. Microscopically the tissue was highly anaplastic with many different shapes of nuclei and cells, some of which contained melanin.

CASE V. (Fig. 6.) A forty-one year old white man had had a primary carcinoma of the thyroid removed nine months previously. The metastatic lesion was solitary and circumscribed, occurring in the left frontal lobe, and had invaded the meninges

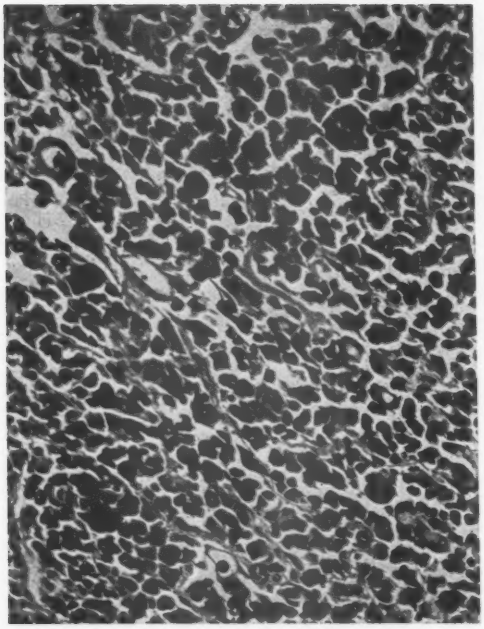


FIG. 5. Case IV. Metastatic melanosarcoma, left frontoparietal area. Hematoxylin and eosin stain.

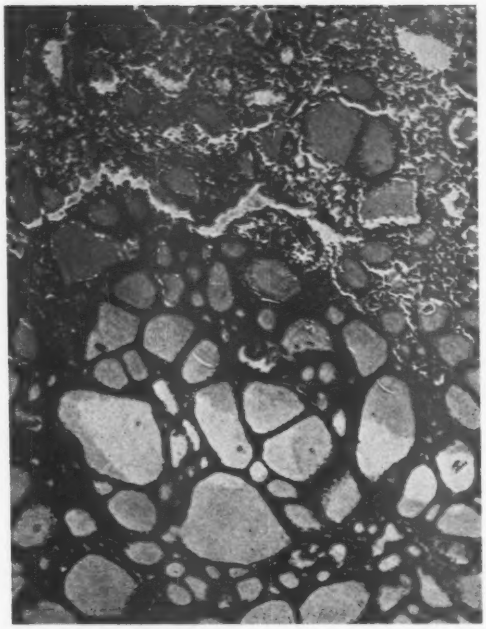


FIG. 6. Case V. Metastatic carcinoma of the thyroid, right frontal lobe. Hematoxylin and eosin stain.

and overlying skull. Ordinary thyroid tissue was apparent, but masses of tumor cells had replaced the normal interfollicular connective tissue. These had small pyknotic nuclei, mitotic figures and pale cytoplasm, and frequently formed sinusoids.

COMMENTS

One of the problems which neurosurgeons face is the diagnosis of tissue of neoplasms lying beneath the cortical surface. The principle of needle biopsy has been applied to obtaining tissue from such lesions in order to minimize damage to overlying structures. Aspiration with a straight hypodermic needle was found early to be unsatisfactory. A modification of the standard needle is the one having a blunt end and apertures in the side through which tissue is removed by aspiration. Frequently the specimen obtained is too small for accurate diagnosis by frozen section.

Another method of biopsy employs a small twist drill which is inserted through a 0.5 cm. linear incision of the scalp down to the skull, which is then perforated by a twisting motion [2]. The drill is carried through the dura, following which a blunt-tipped biopsy needle is used to withdraw tissue suitable for smears. Such tissue is often not sufficient for formalin fixation and permanent sections.

Disadvantages of the cannula described in this report are: (1) an opening must be made with a large twist drill or cranial burr to accommodate the cannula; and (2) its diameter, being greater than that of commonly used instruments for biopsy, allows one to obtain a plug of tissue suitable for permanent sections, but carries with it a greater possibility of vascular injury.

In addition to the histological problem, the hemostatic problem is a formidable one. In directly approaching an intracerebral lesion by dissection, significant bleeding can be directly observed and at least theoretically controlled. The needle plunged into a hidden mass might as easily open a vessel as obtain a specimen. A dilemma exists also with respect to the size of the specimen, for the more adequate the specimen the larger the instrument used for biopsy must be, increasing the potential danger to blood vessels. An advantage of the new cannula which may be of some importance is that there seems to be less likelihood of implanting neoplastic cells along its track, since tissue is obtained cleanly and not strewn upon with-

drawal. A larger plug of tissue may also be subjected to certain biochemical studies which are impossible with smaller specimens.

Dekaban [3] has presented evidence that ventriculography and insertion of electrodes into the brain produce necrosis of tissue, thinning of neural parenchyma, gliosis and demyelination. Progressive cytologic alterations (gliosis) following brain wounds in animals have been described by del Rio-Hortega and Penfield [5]. Astrocytes in the path of the wound undergo rapid clasmatodendrosis and disappear.

When blood supply is disturbed but not abolished, a rapidly constructive reaction ensues, following stages of cellular swelling, division and fibrillation. Removal of a column of cerebral tissue in a hollow needle results in a fluid-filled tract without gliosis. When a stab wound is made with a needle of the same size, whose end is closed, concentric gliosis is produced about the core of connective tissue [4]. Clean excision with no injured cerebral tissue left in place results in a fluid-filled space almost free from gliosis.

SUMMARY

1. A cannula for biopsy of the brain is described.

2. A unique feature of the instrument is the interior circular cutting edge at the end of the cannula.

3. An innovation in proper technic for use of the side arm of the cannula is reported. The cannula is insulated to the tip with Tygon® or varnish so that coagulating currents may be applied while it is in place.

4. Photomicrographs of stained permanent sections of brain tissue removed through the cannula are presented.

Acknowledgment: The technical advice of Mr. John Debroske is appreciated. Permission to cite Case II was kindly given by Dr. C. Spicknall.

REFERENCES

1. Biegeleisen, H. I. New biopsy needle. *Am. J. Surg.*, 94: 678–682, 1957.
2. Cone, W. V. Personal communication, 1958.
3. Dekaban, A. Is needle puncture of the brain entirely harmless? *Neurology*, 8: 556, 1958.
4. Penfield, W. Cytology and Cellular Pathology of the Nervous System, vol. II, p. 458. New York, 1932. Paul B. Hoeber, Inc.
5. del Rio-Hortega, and Penfield, W. Cerebral cicatrix; reaction of neuroglia and microglia to brain wounds. *Bull. Johns Hopkins Hosp.*, 41: 278, 1927.

A New, Rapid Technic for Taking X-ray Films During Surgery

STUART R. JAFFEE, M.D., *Boston, Massachusetts*

From the Peter Bent Brigham Hospital, Boston, Massachusetts; and the Veterans Administration Hospital, West Roxbury, Massachusetts.

X-RAY films of the kidney taken during surgery can be of great value either in localizing calculi or demonstrating that all have been removed. Even with the most efficient radiologic equipment and personnel, however, the time between exposure and viewing is at least six minutes and, in most cases, closer to ten. When more than one film is necessary, the loss of time is even more significant. In order to shorten this interval, the Polaroid® system of rapid photographic development has been adapted for taking x-ray films in the operating room.

MATERIAL

The materials necessary for preparation of these x-ray films are shown in Figure 1.* With the exception of the lightproof box, which was specially constructed, these items are available from photographic supply dealers. The Polaroid film holder No. 500 is similar to a conventional 4 by 5 inch film holder with the addition of a set of rollers for processing the film.

A Polaroid 4 by 5 inch film pack consists of a lightproof paper envelope containing three elements. One is a film base negative coated with a silver halide emulsion. Attached to this is a "pod" of developer which can be crushed by

* The Polaroid equipment was generously supplied by the Polaroid Corporation, Cambridge, Massachusetts.

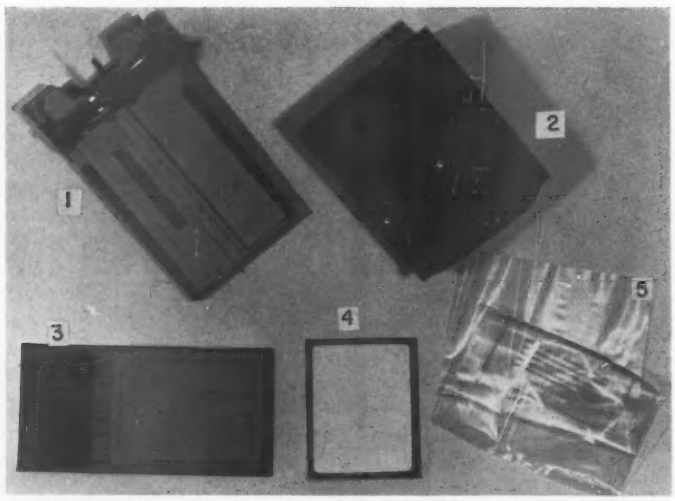


FIG. 1. Materials needed for preparation of x-ray film are: (1) Polaroid land film holder No. 500; (2) lightproof box; (3) Polaroid film pack; (4) intensifying screen; and (5) polyethylene sheath which can be cold-sterilized.

2A 2B

FIG. 2. A, autopsy specimen of kidney containing calculi. B, needles to localize calculi.

the rollers to spread the chemical evenly over the exposed emulsion. The third component is a receiving sheet upon which the positive print appears.

The intensifying screen is a thin, 4 by 5 inch, laminated sheet which is moderately flexible and coated with a high-speed phosphor. This screen is inserted into the Polaroid envelope so that its fluorescent surface is in contact with the light-sensitive emulsion of the film. The screen is placed in the pack in a lightproof box. Necessary manipulation is carried out through an opaque finger cot attached to an opening in the top of the box. This process can also be done in a dark room.

Asepsis in the operating room is maintained by slipping the film pack into a sheath of either cold sterilized polyethylene or autoclaved latex.

PROCEDURE

The entire process of adding the intensifying screen and then processing the film takes place in the operating room. After the envelope has been placed in its sterile sheath, which is held open by a member of the operating team, it is put into position behind the mobilized kidney.

For localization of a stone, two round-point needles are introduced through the parenchyma to the approximate locus of the stone. Two film envelopes are held in position at right angles to each other, medial and inferior to the kidney, and simultaneously exposed by the roentgen ray. By comparison of the two prints, which are available in sixty seconds, the position of the calculus can be determined.

Exposure of a single film is sufficient to establish the completeness of removal of the stone.

Exposure data are: 25 ma. sec. at 36 kv. with the x-ray source 36 inches from the film. The quality of films obtained by this technic is shown in Figure 2.

SUMMARY

The taking of x-ray films during surgery has been a time-honored but time-consuming technic. An adaptation of the Polaroid principle of rapid photographic development is described. This one-minute process lends itself particularly to nephrolithotomy.

CASE REPORTS

Retroperitoneal Non-chromaffin Paraganglioma

ROBERT T. SESSIONS, M.D. AND H. WILLIAM SCOTT, JR., M.D., *Nashville, Tennessee*

From the Department of Surgery, Vanderbilt University School of Medicine and Hospital, Nashville, Tennessee.

NON-CHROMAFFIN paraganglioma is the term applied to those tumors which are histologically similar to tumors of the cartoid body but which occur in regions of the body other than the head and neck. They have been reported to arise in the mediastinum [*14*], the abdominal cavity [*1,2*], the retroperitoneal space [*4*] and the extremities [*22*]. The cells of non-chromaffin paragangliomas are similar to those of the carotid body, aortic body and glomus jugulare in that they do not demonstrate the chromaffin reaction, do not elaborate epinephrine and have primarily a sensory innervation [*4*]. The carotid and aortic bodies function as chemoreceptors which are sensitive to changes in arterial blood resulting in reflex changes in respiration and sympathetic nervous system activity. The difficulties involved in the classification of intra-abdominal and retroperitoneal non-chromaffin paragangliomas arise from the fact that no normal accumulations of chemoreceptor cells have been described in these locations in man although they have been identified in rats and mice [*9*].

These rare neoplasms were described in 1951 by Smetana and Scott [*23*] who called attention to a group of fourteen tumors observed at the Armed Forces Institute of Pathology which had previously most often been classified as malignant granular cell myoblastomas. Smetana and Scott noted that in all instances the microscopic picture in these relatively large, slowly growing, painless tumors was similar and resembled that of tumors of the carotid body. Four of the tumors which they reported originated within the retroperitoneal space. A noteworthy observation they made was a tendency for the tumors to recur locally and to metastasize. Nine of the ten patients whom they followed up either died with metastasis or were known to have metastasis at the time of their report. This propensity toward metastasis was reaffirmed by Christopherson, Foote and Stewart [*6*].

Reports concerning the surgical treatment of non-chromaffin paragangliomas have appeared in the medical literature in the past four years. Arneill, Haigler and Gamboa [*2*] reported a case in a sixty-eight year old white man who sought medical advice because of a painless mass in the right upper quadrant. He subsequently underwent seven major operations in the next eleven years for removal of recurrences before undergoing a radical procedure in which large masses of bowel and tumor were removed, leaving him asymptomatic for the year prior to publication. Arean and De Arellano [*1*] reported a case in a thirty-two year old Negro man who had a two-year history of recurrent abdominal pain and a mass in the right lower quadrant. At operation radical removal of much of the ileum was undertaken because of a large tumor in its mesentery. Except for occasional bouts of diarrhea, the patient was well almost a year later. Block, Dockerty and Waugh [*4*] described a nineteen year old white man who gave a five-year history of recurrent abdominal pain associated with an abdominal mass. At operation, a large non-chromaffin paraganglioma was removed from the retroperitoneal space to

the right of the sacral promentory. No follow-up data were given but the authors stated that at operation there was no evidence of distant metastases.

The following case of non-chromaffin paraganglioma is presented as an example of the extent of radical surgical extirpation which may be necessary for adequate treatment of this tumor and the value of vascular grafts in making this possible.

CASE REPORT

J. A. A. (VUH 266748), a seventeen year old white male student, was admitted to Vanderbilt University Hospital March 17, 1957, for evaluation of a large retroperitoneal tumor which had been biopsied in another hospital. He had first noted vague pains of minor nature in his "right side" five years prior to admission. One year later he underwent appendectomy because of acute appendicitis. A few months later the pain, described as a dull aching throb beneath the appendectomy scar, recurred and he noted that it was more severe after exercise. This pain did not radiate, was not associated with changes in bowel function, urinary symptoms or weight loss, and was noted to be brought on by progressively smaller amounts of exercise. One year prior to admission the pain was more constant, became localized to the right upper quadrant, and he became conscious of a mass in his epigastrium. Three months later exploration was performed at another hospital and a large retroperitoneal tumor which involved the great vessels was found. A small portion of the tumor was removed for biopsy. The surgeon stated that the tumor was extremely vascular. The initial pathologic diagnosis was "malignant hemangio-endothelioma." After operation a course of deep x-ray therapy was given which resulted in no change in the size of the tumor or in symptomatology. In the subsequent nine months he gained weight and felt well, except for the constant, aching, abdominal pain. The microscopic sections were reviewed by the Armed Forces Institute of Pathology and were interpreted as "non-chromaffin paraganglioma." With this information the patient was referred to Vanderbilt University Hospital.

On physical examination, the patient was a well developed, slightly obese, young, white man in no distress. Pertinent findings were limited to the abdomen on which were the well healed scars of McBurney and right upper paramedian incisions. There was a large mass filling the mid-abdomen and projecting into the right upper quadrant. The mass was firm, non-tender and immobile. Peripheral pulses were normal, and there was no venous distention or edema.

Studies of the blood and urine were within normal limits. A barium enema revealed no intrinsic defect in the colon, but a constant displacement of the descending colon and sigmoid toward the right was noted. Intravenous pyelograms showed normally functioning kidneys but demonstrated a soft tissue mass at the level of the second to fourth lumbar vertebral bodies which displaced the lower pole of the right kidney and the upper portion of the right ureter lateralward. (Fig. 1.) An x-ray film of the chest and skeletal survey revealed no evidence of metastases.

FIG. 1. Intravenous pyelogram demonstrating lateral displacement of the right kidney by the retroperitoneal mass.

At operation on March 27, 1957, with the patient under general endotracheal anesthesia, the abdomen was explored through a right paramedian incision which was extended into the right eighth intercostal space. There was a large, firm, irregular, lobulated tumor in the retroperitoneal space overlying the abdominal aorta and inferior vena cava. The posterior peritoneum was incised and reflected, and the transverse duodenum was retracted superiorly. The grayish pink tumor completely surrounded the aorta and inferior vena cava from their bifurcation to the renal vessels. The right renal vessels were encased in tumor but the left renal pedicle was not involved. Superiorly, the tumor extended posterior to the aorta up to the diaphragm. Immediately inferior to the right renal vein, the tumor had invaded the posterior wall of the vena cava. (Fig. 2.)

Complete excision of the extremely vascular tumor could be effected only by *en bloc* removal of the tumor with the involved segments of the lower

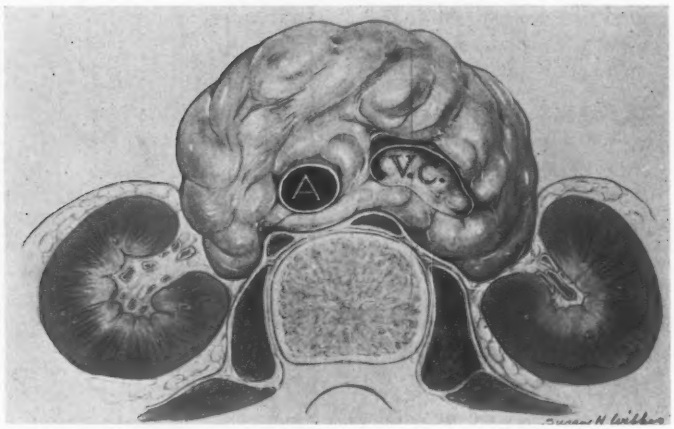


FIG. 2. Sketch illustrating in transverse section the large non-chromaffin paraganglioma surrounding the aorta and invading the inferior vena cava.

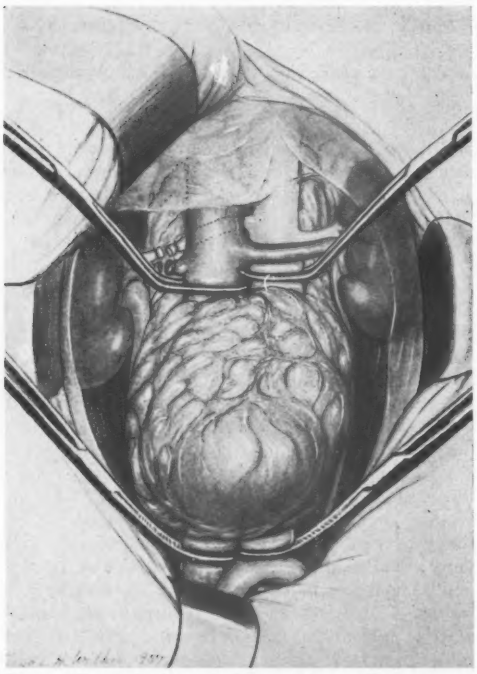


FIG. 3. Frontal view of the non-chromaffin paraganglioma prior to transection of the aorta and inferior vena cava.

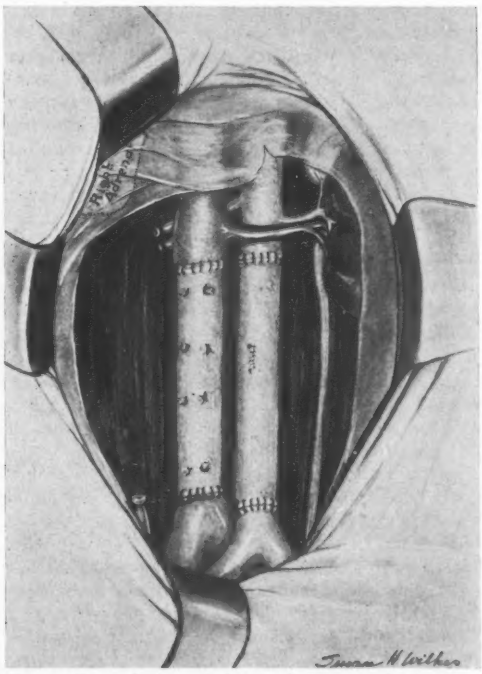


FIG. 4. Frontal view of the aortic homografts inserted into the aorta and inferior vena cava following the reestablishment of blood flow.

abdominal aorta, inferior vena cava and right kidney. After mobilizing the tumor laterally, the aorta and vena cava were clamped and transected above and below the tumor. (Fig. 3.) The inferior mesenteric artery and lumbar vessels were divided and, with the specimen elevated, the upper portion of the tumor was dissected off the posterior aspect of the aorta from the diaphragm downward. The tumor was dissected off a short segment of the left renal artery posteriorly. However, because of

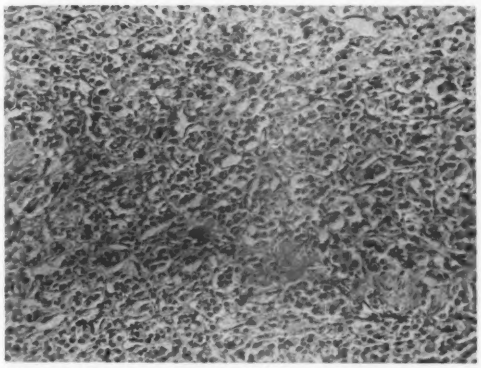


FIG. 5. Photomicrograph of the non-chromaffin paraganglioma.

complete encasement of the right renal pedicle by tumor, these vessels were sacrificed, and the right kidney was removed with the specimen. Two lyophilized thoracic aortic homografts were reconstituted and 12 cm. segments of graft were used to restore the continuity of the aorta and vena cava. (Fig. 4.) The anastomoses were accomplished with continuous over and over No. 4-0 silk sutures. At the conclusion of the procedure it became apparent that there was a thrombus present within the homograft joining the two ends of the aorta. Accordingly, a 2 cm. longitudinal incision was made in the midportion of the graft and the thrombus was easily removed. The small incision was closed and blood flow was re-established through both vessels. The posterior peritoneum was approximated over the grafts and the thoracoabdominal wound was closed in layers with water-sealed drainage of the chest. Massive blood replacement was necessary during the extensive procedure which the patient tolerated well.

Examination of the gross specimen revealed an irregular, soft, nodular, grayish pink tumor which measured 15 by 8 by 8 cm. and showed areas of fibrosis and cystic degeneration. The aorta, which was surrounded by adherent tumor, was not grossly invaded but soft, nodular tumor tissue was seen invading through the posterior wall of the vena cava and projecting into its lumen.

Microscopically the tumor had infiltrated through the entire wall of the vena cava but had penetrated only the adventitia of the aorta. Sections of the tumor showed nests and clusters of cells surrounded by either a delicate reticular network or more dense bundles of collagenous fibers. (Fig. 5.) There were numerous small blood vessels throughout the stroma. The individual tumor cells were uniform in appearance with vesicular nuclei and generous quantities of finely granular pink cytoplasm. Many of the nuclei were dense and pyknotic, but nucleoli were not numerous and mitoses were not seen.

FIG. 6. Phlebogram with 50 per cent Hypaque demonstrating patency of the homograft in the inferior vena cava twenty months after operation.

Lymphocytes were seen in hyalinized connective tissue surrounding areas of cystic degeneration; in some areas recent and old hemorrhage was noted. The pathologic diagnosis was non-chromaffin paraganglioma.

In the postoperative period the patient did very well. Urinary output was normal, and arterial pulsations in the legs and feet were satisfactory. There was no evidence of venous distention or edema. The thoracoabdominal wound healed *per primam* and he was discharged relatively asymptomatic on the tenth postoperative day.

The patient was followed up for twenty months postoperatively and was last examined in November 1958. Since discharge from the hospital he has done well. There has been no pain but he has been bothered by somewhat irregular constipation and flatulence. He has continued to gain weight and is rather obese. On examination the operative incision was well healed, peripheral pulses were normal and symmetrical; there was no edema or obvious venous distention of the lower extremities, and no mass was palpable within the abdomen. There was no clinical or radiologic evidence of recurrence or metastasis. Infra-red photographs showed a normal venous pattern, and intravenous pyelogram showed normal function of the remaining kidney. Phlebography with 50 per cent Hypaque® demonstrated patency of the grafted inferior vena cava with no apparent constriction of its lumen. (Fig. 6.)

COMMENTS

Although the patient described herein had been aware of his tumor for only one year prior to its removal, his history and the apparently slow growth of the tumor during the time it was observed suggest that this neoplasm was of rather long duration and could conceivably have been present for five years before operation. The lengthy course, the microscopic appearance of the tumor and the results of a twenty-month follow-up suggest that this tumor was behaving in a benign fashion. The invasion of the aorta and vena cava, on the other hand, are good evidence of the tumor's malignant potentialities. These facts are in keeping with what is known about the non-chromaffin paragangliomas but raise certain clinical questions regarding the relationship of these neoplasms with other tumors of the chemoreceptor system.

The similarities noted between the non-chromaffin paragangliomas and tumors of the carotid body or glomus jugulare are generally made on microscopic grounds. In each tumor one sees nests or clusters of large cells which resemble epithelium and which are surrounded by a reticular network containing large numbers of capillaries. In most instances the tumors are intimately related to blood vessels; in many instances the vessel wall has been invaded by tumor.

The clinical differences between these morphologically similar tumors are probably explainable on the basis of their critical anatomical locations [*21*]. Tumors of the carotid body are located beneath the angle of the mandible at the level of the bifurcation of the common carotid artery. They are generally painless but their superficial location allows them to be noted early in their course. Tumors of the glomus jugulare originate in the wall of the jugular bulb beneath the floor of the middle ear. Depending on the direction of bony erosion and the size of the tumor, patients may present signs of aural pathology, cranial nerve deficit or evidence of an intracranial mass.

Although tumors of the carotid body are considered benign tumors by some authors [*17*], others [*21*] have shown clearly that these tumors can metastasize widely in a small percentage of patients. It has also been noted that some tumors of the glomus jugulare may metastasize [*12*]. The rather discouraging results reported by Smetana and Scott [*23*], and the propensity toward recurrence noted by Arneill, Haigler and Gamboa [*2*] call attention to the fact that non-chromaffin paragangliomas behave in a much more malignant fashion than do tumors of the carotid body or glomus jugulare.

It has been suggested that the malignant characteristics observed in non-chromaffin paragangliomas might be related to the extensive vascularity and the intimate relationship of the tumor cells to capillaries. This, however, does not explain the difference in frequency of metastasis observed between these tumors and those of the carotid body or glomus jugulare which are equally as vascular but metastasize much less frequently. Irrespective of the reason for this difference, the common clinical behavior of these neoplasms, i.e., the rather slow growth with a propensity to local recurrence and distant spread, and the fact that similar tumors have not proved radiosensitive, does suggest that early radical surgical removal may be the treatment of choice.

The anatomical make-up of the retroperitoneal space allows for a long period of growth and the attainment of unusual size before a tumor in this location produces symptoms; often a palpable mass is the first clinical manifestation. Because retroperitoneal tumors are generally far advanced when their presence is discovered, adjacent organs are very commonly involved and in the past surgical resection was not believed practicable because of compromise of vital structures by tumor.

Pack and Tabah [*16*] reviewed 120 primary retroperitoneal tumors and noted that in 71.6 per cent of the patients the tumor had infiltrated or was intimately adherent to adjacent organs, and in 39 per cent of the patients major blood vessels were either surrounded or infiltrated by tumor. This was found to be the most common cause for inoperability and was an important factor contributing to a fatal outcome. The authors suggested that in the future improved results could be anticipated by a combination of earlier diagnosis, more aggressive surgery, and by means of reconstructing or repairing vital blood vessels which must be sacrificed because of involvement by tumor.

The use of grafting procedures for the replacement or bypass of major arteries is now well established, and a variety of arterial substitutes are widely used in the treatment of

aneurysms and arterial occlusive disease. More recently these technics have been utilized in the resection of neoplasms [7].

Although it has been known for some time that the vena cava may be sacrificed or ligated below the level of the renal veins without undue harm to the patient (or in some cases even symptoms), invasion of the vena cava by a tumor has generally been considered as strong evidence of non-resectability of the lesion. It has only been in the past few years that removal of the inferior vena cava in resection of tumors has been undertaken [13], and the utilization of a graft to restore caval continuity after such procedures has been rarely attempted.

The experiences of Ashburn, Sewell and Huggins [3] Sauvage and Weslowski [19], Gerbode [20], and Ohara and Sakai [15] with various types of grafts and prosthetic devices as substitutes in the venae cavae of several types of laboratory animals have been disappointing. In general, it is clear that prolonged and consistent maintenance of blood flow through grafted venous systems is difficult to obtain and that no combination of vascular substitutes or operative technic has yet been developed which consistently prevents the partial or complete failure of the graft.

Although there has been considerable experimental work on grafting in the venous system, clinical experience is limited. Many of the grafting attempts reported have been performed because of obstruction of the superior vena cava by malignant tumors, and evaluation of the graft alone has often been complicated by the uniformly fatal course of the primary disease [3,8,10,11]. In several cases the grafts had remained patent during periods of observation varying from a few weeks [10] to fourteen months [18]. Grafting procedures involving the inferior vena cava have been rarely reported. Crawford and De Bakey [7] described a patient in whom aortic homografts were used to replace the inferior vena cava and aorta after resection of a malignant tumor, but the caval graft was found to be thrombosed four months after operation.

Blum, Medl and Keefer [5] reported the first successful substitution of a graft for the postrenal inferior vena cava. Their patient was a twenty-nine year old white woman with agenesis of the supracardinal portion of the inferior vena cava. A lyophilized aortic bifurcation homograft was used and phlebography demonstrated the patency of the graft one year after operation.

The case we have described apparently represents the second recorded instance in which a graft interpolated into the inferior vena cava has maintained its patency for a prolonged period of time. The graft used was an ethylene oxide-sterilized, lyophilized, thoracic aortic homograft. It has remained patent for twenty months with no evidence of contraction of its lumen or cicatricial stenosis of the suture lines as demonstrated by phlebography. This is particularly gratifying in as much as the tumor, which was apparently completely removed at operation, had invaded through the wall of the patient's vena cava and had presumably been in the caval wall for many months. In the past, similar findings would have placed this neoplasm in the group of non-resectable lesions.

SUMMARY

Non-chromaffin paragangliomas are rare tumors which are morphologically similar to tumors of the chemoreceptor system but which are more frequently malignant. A case of retroperitoneal non-chromaffin paraganglioma treated by radical excision with successful replacement of the aorta and inferior vena cava by aortic homografts is presented. The tumor was of long duration, had not responded to radiation therapy, and had invaded the vena cava and aorta. Twenty months after operation the grafts were demonstrated to be patent, and there was no clinical evidence of recurrence of the tumor. This case apparently represents the second recorded instance in which a graft interpolated into the inferior vena cava has continued to function for a prolonged period.

ADDENDUM

Since the time of writing, an additional twelve months of follow up on the patient has revealed no subsequent evidence of recurrence of the tumor or failure of the grafts.

REFERENCES

1. Arean, V. M. and De Arellano, G. A. R. Intra-abdominal non-chromaffin paraganglioma. *Ann. Surg.*, 144: 133, 1956.
2. Arneill, J. R., Haigler, S. H. and Gamboa, L. G. Malignant intra-abdominal non-chromaffin paraganglioma. *J. Internat. Coll. Surgeons*, 22: 656, 1954.
3. Ashburn, F. S., Sewell, W. H. and Huggins, C. E. Experimental replacement of superior vena cava with homologous arteries and report of a case

with malignant obstruction replaced with a heterologous artery. *J. Thoracic Surg.*, 31: 618, 1956.

4. Block, M. A., Dockerty, M. B. and Waugh, J. M. Non-chromaffin paraganglioma: report of a case. *Cancer*, 8: 97, 1955.
5. Blum, L., Medl, W. T. and Keefer, E. B. C. Aortic homograft substitution for the post-renal inferior vena cava. *Arch. Surg.*, 72: 567, 1956.
6. Christopherson, W. M., Foote, F. W., Jr. and Stewart, F. W. Alveolar soft-part sarcoma, structurally characteristic tumors of uncertain histogenesis. *Cancer*, 5: 100, 1952.
7. Crawford, E. S. and De Bakey, M. E. Wide excision including involved aorta and vena cava and replacement with aortic homograft for retroperitoneal malignant tumors: report of two cases. *Cancer*, 9: 1085, 1956.
8. Deterling, R. A., Jr. and Bhonslay, S. B. Use of vessel grafts and plastic prostheses for relief of superior vena caval obstruction. *Surgery*, 38: 1008, 1955.
9. Goormaghtigh, N. On the existence of abdominal vagal paraganglia in the adult mouse. *J. Anat.*, 71: 77, 1936.
10. Higginson, J. F. Aortic homograft substitution and by-pass in superior vena cava obstruction. *J. Thoracic Surg.*, 32: 684, 1956.
11. Holman, C. W. and Steinberg, I. Treatment of superior vena caval occlusion by arterial graft: preliminary report. *J. A. M. A.*, 155: 1403, 1954.
12. Lattes, R. and Waltner, J. G. Non-chromaffin paraganglioma of the middle ear (carotid-body-like tumor; glomus jugulare tumor). *Cancer*, 2: 447, 1949.
13. Marshall, V. F. and Schmidlapp, C. J., II. Partial excision of the inferior vena cava in the removal of tumors. *Cancer*, 2: 316, 1949.
14. McDonald, O. G., Aufderheide, A. C. and Fuller, J. Chemodectoma (non-chromaffin paraganglioma) of the mediastinum. *Ann. Surg.*, 140: 254, 1954.
15. Ohara, I. and Sakai, T. Transplantation of the large venous system with various blood vessel substitutes. *Surgery*, 42: 928, 1957.
16. Pack, G. T. and Tabah, E. J. Primary retroperitoneal tumors, a study of 120 cases. *Internat. Abstr. Surg.*, 99: 209–231, 313–341, 1954.
17. Pettet, J. R., Woolner, L. B. and Judd, E. S., Jr. Carotid body tumors (chemodectomas). *Ann. Surg.*, 137: 465, 1953.
18. Reveno, W. S., Reynolds, L. and Dodrill, F. D. Occlusion of both immoninate veins; restoration of blood flow by arterial graft. *J. A. M. A.*, 159: 1192, 1955.
19. Sauvage, L. R. and Weslowski, S. A. Anastomoses and grafts in the venous system with special reference to growth changes. *Surgery*, 37: 714, 1955.
20. Gerbode, F. L. Discussion by Scannell, J. G. and Shaw, R. S. Surgical reconstruction of the superior vena cava. *J. Thoracic Surg.*, 28: 163, 1954.
21. Sessions, R. T., McSwain, B., Carlson, R. I. and Scott, H. W., Jr. Surgical experiences with tumors of the carotid body, glomus jugulare and retroperitoneal non-chromaffin paraganglia. *Ann. Surg.*, 150: 808, 1959.
22. Sirsat, S. Malignant non-chromaffin paraganglioma of foot. *Indian J. M. Sc.*, 8: 800, 1954.
23. Smetana, H. F. and Scott, W. F., Jr. Malignant tumors of non-chromaffin paraganglia. *Mil. Surgeon*, 109: 330, 1951.

Gas Gangrene without Visible Portal of Entry

WILLIAM A. WHYLAND, M.D., *Troy, New York,* AND MURRAY N. LEVIN, M.D., *Manchester, New Hampshire*

From the Veterans Administration Hospital, Manchester, New Hampshire.

THE incidence of clostridial myositis following injuries, both military and civilian, has been widely reported in the medical literature. The usual history of traumatic wounds contaminated with clostridia with ensuing gas gangrene conjures up a vision of severely damaged tissue with poor blood supply, and easy means of inoculation and growth of the offending organism. It has been shown that while over 50 per cent of severe traumatic wounds may be contaminated with clostridia [1], less than 2 per cent develop clinical gas gangrene [2]. Lowry and Curtis [3], in their excellent monograph on clostridial myositis, point out several etiologic factors which favor the development of this condition and group them in the probable order of their importance: (1) major vascular injury, (2) compound fractures, (3) prolonged time interval between wounding and treatment, (4) wounds contaminated with manured soil, (5) wounds of the thigh and buttocks, (6) severe wounds, with marked destruction of tissue, and (7) wounds contaminated by woolen clothing.

In reviewing the various etiologic factors of this disease, one stands out—the presence of a wound which serves as a portal of entry for the infective organisms. Reported herein is a case of true clostridial myositis with no visible wound or injury to provide an avenue of infection.

CASE REPORT

C. K., a seventy year old white man, was admitted to the Manchester Veterans Administration Hospital on May 14, 1958, with the chief complaint of a mass which presented at the anal verge with each bowel movement. This had been noted for about one year and was accompanied by bloody stools during that time. The mass had grown larger, and it became necessary to replace it digitally after each defecation. The stool had diminished in caliber to about the size of a pencil for approximately six months prior to admission. The patient had not seen a physician until two days before admittance to the hospital.

The patient also offered the incidental complaint of a tender spot on the lower third portion of the left thigh which he noted on the day of admission. He denied any trauma to this area and any recent injuries to any part of his body.

Physical examination revealed the patient to be flushed, with a temperature of 99.4°F. and a pulse of 80. The significant findings were: (1) a large mass (approximately 8 by 6 by 5 cm.) in the lower part of the rectum, easily felt with the palpating finger, which was movable and appeared attached to the anterior rectal wall, and (2) a fusiform enlargement (5 by 3 by 2 cm.) over the lateral aspect of the lower third portion of the left thigh which was tender, slightly erythematous and moderately firm. There was no bruit, fluctuation or sharp area of demarcation. The process was not felt to be superficial. Dorsalis pedis and posterior tibial pulses were of good quality bilaterally. Close inspection did not disclose any lesions on the body which might present an avenue of invasion by a pathogenic organism.

The clinical impression was carcinoma of the rectum and possibly a deep abscess of the thigh of undetermined etiology. An x-ray film of the thigh showed a diffuse swelling of soft tissue on the lateral aspect just superior to the lateral epicondyle. Since the diagnosis was doubtful, the area was aspirated in the hope of obtaining pus. Instead, only one or two drops of serosanguineous tissue fluid was obtained for culture. On the same evening the temperature suddenly increased to 102°F. and the pulse was 108. By the next morning the area of inflammation had nearly doubled in size and was more tender but still not fluctuant. At that time a preliminary bacteriologic report was received that

FIG. 1. Radiograph of left thigh, lateral view, showing bubbles of gas in anterior portion of lower third. X-ray was taken two days after patient's admission.

gram-positive anaerobic gas-forming organisms were present, probably clostridia. Another x-ray film was immediately taken which showed the presence of small gas bubbles in the area of the swelling. (Fig. 1.) A diagnosis of gas gangrene was made, and the patient was given 600,000 units of crystalline penicillin intramuscularly and 4 vials of polyvalent gas gangrene antitoxin intravenously. Two grams of sulfadiazine were dissolved in 1,000 cc. of 10 per cent invert sugar in distilled water and administered intravenously.

The patient was taken to the operating room where an incision was made from the lateral epicondyle to the greater trochanter over the involved area. Inspection revealed moderate edema of the muscles which were a grayish pink color and did not bleed when cut. Most of the vastus lateralis, vastus intermedius and rectus femoris were excised by the time freely bleeding muscle was seen. Several large drains were inserted deep into the wound which was also packed open. Specimens of muscle were cultured, and Clostridium welchii and anaerobic streptococci were isolated (Figs. 2 and 3.) A pathologic diagnosis of clostridial myositis was made.

Following surgery the patient received heavy doses of penicillin, sulfadiazine and gas gangrene antitoxin, and the daily care of the wound consisted of irrigation with Furacin® solution and packing with gauze saturated with this preparation. Soon after his operation the patient manifested a disoriented, belligerent attitude accompanied by visual hallucinations. This was believed to be secondary to the toxemia of the disease and was treated satisfactorily with chlorpromazine administered intramuscularly. The wound healed well in approximately four weeks.

Shortly after surgery, Cl. welchii was isolated from the patient's stool along with the usual coliform organisms and anaerobic streptococci.

Although repeated biopsies of the rectal mass were reported as adenomatous polyp, the size, location and proctoscopic appearance of the lesion caused us to decide upon abdominoperineal resection of the rectum. The bowel was prepared with Sulfasuxidine,® 3 gm. administered every six hours for six days, in addition to neomycin, 1 gm. every four hours during the last forty-eight hours before operation. The proposed operation was performed on July 30, 1958, and culture of the sigmoid colon at surgery, both proximal and distal to the line of transection, was positive only for Cl. welchii. Pathologic study revealed the resected lesion to be a grade 1 adenocarcinoma. There was no evidence of metastases. The patient made a good recovery, was able to ambulate well with the aid of a cane, and was discharged on August 22, 1958.

COMMENTS

We believe this case demonstrates the occurrence of clostridial myositis in the absence of the usual pre-existing factors. Even though no visible portal of entry was apparent, it was obvious that an avenue of infection was present. We postulate that it was through the rectal tumor, which was of friable, easy bleeding tissue, and which was digitally manipulated by the patient after every bowel movement. Subsequent embolic spread to the muscles of the thigh could then take place. The colonic flora contained Cl. welchii, which was the only surviving organism after acceptable preoperative preparation of the bowel.

Why the infection did not occur earlier under the same conditions of manual reduction of the partially prolapsed tumor, or if this was, in fact,

FIG. 2. Photomicrograph of section of muscle of left thigh showing necrosis of muscle cells.

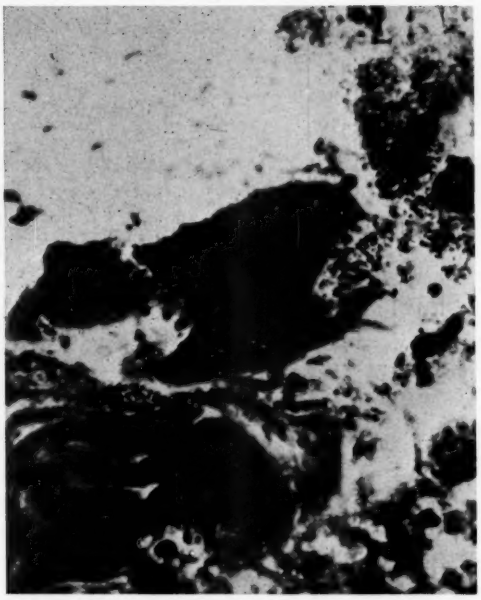


FIG. 3. Higher magnification of same area shown in Figure 2. Photomicrograph shows necrosis of muscle cells and invasion of muscle by C. welchii.

the portal of entry cannot be determined. If bacterial embolism was the mode of dissemination of the clostridia, it is reasonable to assume that the muscles of the thigh might be affected. Millar [4], in a review of 607 cases of gas gangrene, found the heavily muscled areas of the extremities to be the most frequent site of involvement, with the lower extremities affected in 47.5 per cent of all cases.

If there is any lesson to be learned from this report, it might be to raise the index of suspicion of the doctor who sees a patient with an easily palpated, easy bleeding or ulcerated rectal tumor. If the patient shows signs of localized muscular inflammation, clostridial myositis should be considered in the differential diagnosis.

The bacteriologist's rapid report of the pathogen to the surgeon was a vital factor in the successful outcome of this case.

SUMMARY

A case is reported in which a patient with grade 1 carcinoma of the rectum suffered clostridial myositis of the thigh without any visible avenue of infection. Thorough débridement resulted in good healing of the thigh. The hypothesis of portal of entry of the organism through the tumor with embolization to the affected muscles is considered. The patient survived.

Acknowledgment: We wish to thank Dr. Moses Kopel, pathologist, and Mr. Walter Ordway, bacteriologist, of the Manchester Veterans Administration Hospital for their assistance.

REFERENCES

1. MACLENNAN, J. D. and MACFARLANE, M. G. Treatment of gas gangrene. *Brit. M. J.*, 1: 683, 1944.
2. ALTEMEIER, W. A. and FURSTE, W. L. Collective review, gas gangrene. *Surg., Gynec. & Obst.*, 84: 507–523, 1947.
3. LOWRY, K. F. and CURTIS, G. M. Diagnosis of clostridial myositis. *Am. J. Surg.*, 74: 752–757, 1947.
4. MILLAR, W. M. Gas gangrene in civil life. *Surg., Gynec. & Obst.*, 54: 232, 1932.

Retroperitoneal Pelvic Neurofibrosarcoma

DENIS CAVANAGH, M.D., *Miami, Florida,* AND FERNANDO ALONSO-LEJ, M.D., *Baltimore, Maryland*

From the Departments of Gynecology and Surgery, Mercy Hospital, Baltimore, Maryland.

RETROPERITONEAL pelvic neurofibrosarcoma is rare. Only six such cases could be found in a fairly comprehensive review of the literature [1–6]. At the Mayo Clinic, Lovelady and Dockerty [7] in 1949 reviewed 127 cases of extragenital pelvic tumors found in the period 1910 to 1947; of these, only six were neurofibromas. This represents a rate of occurrence of one in 210,000 female admissions. Not a single case of neurofibrosarcoma was found in this series and none of the patients with pelvic neurofibromas showed evidence of cutaneous neurofibromatosis. The following case exhibits both these features.

CASE REPORT

A. P., a thirty-six year old Negro woman, gravida v, para v, was seen in the Gynecologic Clinic with a chief complaint of pain in the right lower quadrant present intermittently for about three years. She had been seen previously in April 1956 when she complained of pain in the right lower quadrant and irregular vaginal bleeding. At that time fractional curettage and multiple-punch cervical biopsies revealed only "chronic endometritis and squamous metaplasia of the cervix." In addition, a neurofibroma was removed from the patient's back. The patient exhibited no other evidence of von Recklinghausen's disease.

After discharge from the hospital the pelvic pain increased, and she was readmitted for further investigation on September 12, 1956. At the time of admission the pain was constant and incapacitating, originating deep in the right iliac fossa and radiating down the right leg. The patient's menses had been regular (every twenty-eight days) since her last admission, each lasting about four days, and the flow was normal. She had no symptoms referable to the urinary system or the bowel.

The patient's past and socioeconomic history were non-contributory. A general systemic examination was negative for abnormalities apart from the pelvic findings.

Pelvic examination revealed a normal vulva and vagina with parous introitus. The cervix was clean. The uterus was normal and mobile. The adnexa were normal but, in addition to the tube and ovary, on the right side a discrete mass was palpated out against the pelvic wall. It was felt to be about 5 cm. in diameter, rounded, with a smooth surface and of firm consistency. Tenderness and marked fixation were evident. No rectal lesions were detected. The diagnosis of retroperitoneal tumor was made, and the possibility of a neurofibroma was considered because of the previous history of a dorsal cutaneous neurofibroma.

On admission the patient's hematocrit was 43 per cent, and fasting blood sugar and blood urea nitrogen were within the normal range. Urinalysis revealed no abnormalities. Intravenous pyelogram and barium enema were normal.

On September 18, laparotomy was performed. The pelvic organs were normal as were the other abdominal viscera. The tumor mass was found to measure about 5 by 4 by 3 cm. and was situated retroperitoneally. It was firmly adherent to the external iliac artery and vein just below the bifurcation of the right common iliac vessels. In view of the obvious hazards of this situation, it was decided to examine a frozen section and only to proceed with complete extirpation if the tumor was malignant. Accordingly, biopsy specimens of the tumor were taken in several places. Even in the course of this procedure considerable hemorrhage was encountered from an aberrant plexus of veins on the surface of the tumor. This bleeding was controlled by pressure on the bleeding site. When the neoplasm was reported to be "benign, possibly a ganglioneuroma," complete removal was not attempted. As much of the mass as possible was removed without damaging the major vessels. Oozing was controlled by pressure, and the posterior peritoneum was closed. The abdomen was closed in layers without drainage.

Postoperatively, a fairly marked paralytic ileus developed but the patient responded to gastrointestinal suction and parenteral fluid therapy. In addition, a small wound hematoma and some paresthesia of the lower part of the left leg developed. The latter sensory phenomenon was not

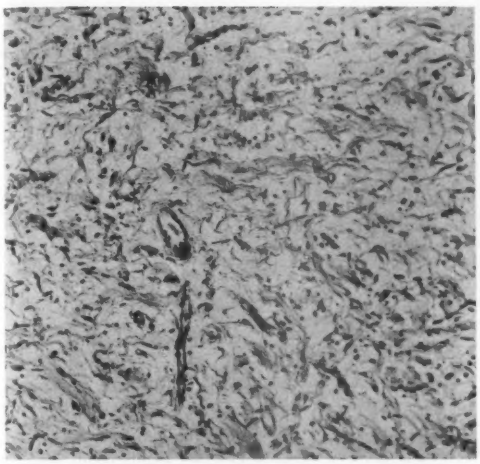


FIG. 1. Lesion of back at twelfth thoracic vertebra.

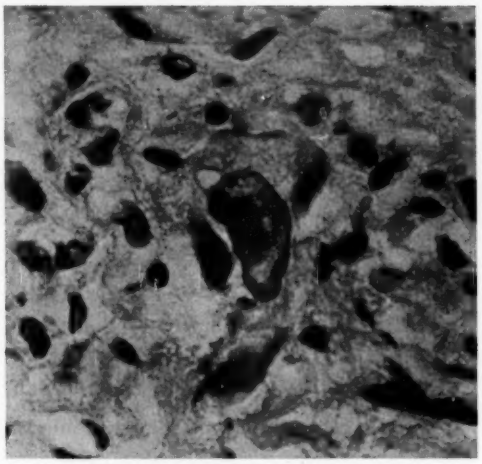


FIG. 2. Tumor from obturator fossa.

anatomic and was considered to be insignificant by the consulting neurologist. The patient was discharged on the eleventh postoperative day at which time hemoglobin, hematocrit and blood chemistries were normal. She was seen at the Gynecology Clinic six weeks later and was feeling much improved, but an incisional hernia was noted. A pathologic diagnosis of neurofibroma with increased nuclear activity was made. In view of the apparent clinical improvement, it was agreed to observe the patient and attempt total resection if symptoms recurred.

In the latter part of 1957 the patient complained of dyspeptic symptoms and pain in the right lower quadrant. Recurrence of the pelvic tumor was suspected but the patient refused operation for a further five months.

At operation on February 20, 1958, two masses were found in the pelvic retroperitoneal space at the site previously described. The larger mass, 3.5 by 2.5 cm., was soft, doughy, pinkish gray, ovoid and encapsulated. Another nodule, 2 cm. in diameter and having the same gross characteristics as the larger tumor, was also found. All gross tumor tissue was removed and the incisional hernia was repaired. The patient's postoperative course was uneventful. At the time of this writing she presented no evidence of metastases.

The microscopic sections were reviewed by six pathologists at different centers, and the following represents their consensus.

In April 1956 excisional biopsy of the lesion of the back over the twelfth thoracic vertebra was interpreted as a neurofibroma with a few cells showing nuclear atypism. (Fig. 1.) In September 1956 biopsies of the tumor mass adherent to the right external iliac vessels showed increased cellularity and cellular atypism sufficient for a diagnosis of malignancy. In February 1958 the two tumor masses removed from the region of the obturator fossa showed malignant change with increased cellular activity and fairly numerous types of giant cells. (Fig. 2.)

COMMENTS

Neurogenic sarcomas arise not from nerve fibers but from nerve sheaths. The embryology has been discussed by Geschickter [*8*], Penfield [*9*] and Stout [*10*]. There is as yet no general agreement on nomenclature nor even on whether the tumors are of mesodermal or neuroectodermal (Schwann cell) origin. The latter source of origin is now accepted for the bulk of these tumors by most pathologists, the multipotency of the Schwann cells having been demonstrated in cultures of tissue. Furthermore, since the term sarcoma implies undoubted mesodermal origin, it has been suggested that the term be abandoned and malignant schwannoma or malignant neurilemmoma substituted. However, since the term neurofibroma continues to be approved universally, there appears to be adequate reason for designating a malignant change in this tumor as neurofibrosarcoma.

The patient discussed herein presented with a single neurofibroma on her back. This tumor, although generally benign, contained a few atypical cells. Its removal was followed five months later by pelvic pain for which laparotomy with partial resection of the tumor was

performed. Histologic examination of the tissue revealed a very cellular neurofibroma with marked nuclear changes and giant-cell forms sufficient for a diagnosis of malignancy. At the second abdominal operation two distinct tumor masses were found, and microscopic sections showed a further increase in atypism with many bizarre giant-cell forms.

This pattern of behavior has been noted by Trueblood [*11*] who lays special emphasis on the more frequent occurrence of malignant change in tumors of the deeper nerve trunks. The tendency to local recurrence following incomplete removal of the pelvic tumor is also seen in the case reported herein. Hosoi [*12*] estimated that in about 13 per cent of patients with von Recklinghausen's disease malignant change developed, and although the patient reported on had only a single cutaneous neurofibroma, it is interesting that malignant change eventually occurred in two tumors of the pelvic nerve sheath.

Neurofibrosarcoma is rarely diagnosed preoperatively although in a patient with von Recklinghausen's disease and a retroperitoneal mass the diagnosis may be suspected. All patients presenting with an ill-defined pelvic tumor should have proctosigmoidoscopy, an excretory urogram and a barium enema. Cystoscopy may be required, and lateral films at cystoretrograde examination are especially helpful in establishing the diagnosis of a retroperitoneal tumor. Such diagnostic procedures as upper gastrointestinal series, pneumoperitoneum, presacral pneumography, aortography and venography may occasionally be required. When the diagnosis of retroperitoneal tumor has been made, an x-ray film of the chest must always precede laparotomy since pulmonary metastases are frequently present [*5,14*].

At laparotomy the retroperitoneal mass may appear friable, vascular and unencapsulated suggesting malignancy. A frozen section technic may be utilized, but even in the most expert hands it may be misleading. It is important to note that multiple biopsy specimens should be submitted to the pathologist since a tumor apparently benign in one part may be malignant in another.

In any retroperitoneal tumor in which malignancy is suspected, total resection should be attempted. This is especially important in a patient with a neurofibrosarcoma, for this type of malignancy is notoriously insensitive to radiotherapy. Not only the tumor but also liberal portions of the nerve trunks of origin should be excised to reduce the possibility of perineural lymphatic spread.

The prognosis in neurofibrosarcoma is fairly good compared with other sarcomas [*13,14*]. Hosoi [*12*] found that metastases were present in only fourteen of sixty-five reviewed cases of neurofibrosarcoma, the most common site being the lung. Metastases to lymph nodes are rare, and death usually occurs from local extension [*15*]. Thus, obstructive uropathy with terminal uremia may be expected in an untreated patient with a neurofibrosarcoma of the pelvic retroperitoneal space.

SUMMARY

Retroperitoneal pelvic neurofibrosarcoma is a rare tumor, and taking pathologic synonyms into account, only six cases could be found in the literature. The patient herein discussed presented with a cutaneous neurofibroma, and after its removal evidence of involvement of the pelvic nerve trunk appeared. The case confirms the impression that incomplete removal of these tumors encourages local recurrence with increased cellular anaplasia.

Total resection is the treatment of choice, and the prognosis is probably better than for other retroperitoneal tumors. These tumors respond very poorly to radiotherapy.

Acknowledgment: We would like to thank Drs. F. K. Morris, Chief of Gynecology, and Daniel Pessagno, Chief of Surgery, Mercy Hospital, Baltimore, Maryland, for their assistance.

REFERENCES

1. Gluge, G. Abandlungen zur Physiologie und Pathologie, p. 140, 1841. Cited by Garré, C. *Beitr. z klin. Chir. Tübing.*, 9: 465–495, 1892.
2. Gerster. Discussion of paper by Adson, A. W., Moersch, F. P. and Kernohan, J. W. Neurogenic tumors arising from sacrum. *Arch. Neurol. & Psychiat.*, 41: 535–555, 1939.
3. Chodoff, R. J. and Conston, A. S. Presacral neurofibrosarcoma. *Am. J. Surg.*, 86: 484–485, 1953.
4. Chodoff, R. J. and Scarf, M. Neurofibrosarcoma; a rare pre-sacral tumor. *J. Albert Einstein M. Center*, 2: 151–158, 1954.
5. Pack, G. T. and Tabah, E. J. Primary retroperitoneal tumors: a study of 120 cases. *Internat. Abstr. Surg.*, 99: 313–339, 1954.
6. Massachusetts General Hospital, case 33332. Retroperitoneal neurofibrosarcoma. *New England J. Med.*, 237: 234–236, 1947.
7. Lovelady, S. B. and Dockerty, M. B. Extragenital

pelvic tumors in women. *Am. J. Obst. & Gynec.*, 58: 215, 1949.
8. GESCHICKTER, C. F. Tumors of peripheral nerves. *Am. J. Cancer*, 25: 377–410, 1935.
9. PENFIELD, W. The encapsulated tumors of the nervous system. *Surg., Gynec. & Obst.*, 45: 178–188, 1927.
10. STOUT, A. P. Peripheral manifestations of the specific nerve sheath tumor (neurilemoma). *Am. J. Cancer*, 24: 751–796, 1935.
11. TRUEBLOOD, D. V. Neurogenic sarcoma. *Surg., Gynec. & Obst.*, 72: 363–371, 1941.
12. HOSOI, K. Multiple neurofibromatosis (von Recklinghausen's disease) with special reference to malignant transformation. *Arch. Surg.*, 22: 258–281, 1931.
13. WARREN, S. and SOMMER, G. N. J., JR. Fibrosarcoma of soft parts with special reference to recurrence and metastasis. *Arch. Surg.*, 33: 425–450, 1936.
14. DONNELLY, B. A. Primary retroperitoneal tumors; report of 95 cases and review of literature. *Surg., Gynec. & Obst.*, 83: 705–717, 1946.
15. WACHSTEIN, M. and WOLF, E. General neurofibromatosis (von Recklinghausen's disease) with local sarcomatous change and metastasis to regional lymph nodes. *Arch. Path.*, 37: 331–333, 1944.

Children nowadays need hospital care less often than they did twenty years ago, largely because the rates for two common operations, tonsillectomies and appendectomies, have declined by about one-half. At the same time, improved surgical technics have increased admission rates for most other operations, especially complicated heart surgery.

Malignant Carcinoid Syndrome and Latest Concepts in Serotonin Metabolism

USE OF CORTISONE, PREDNISONE AND ANTISEROTONIN COMPOUND 45–50

RAIMONDS J. GAILITIS, M.D. AND WERNER SCHEIBER, M.D.,* *Chicago, Illinois*

From the Department of Internal Medicine, University of Illinois, Chicago, Illinois.

CASE 1. A forty-three year old Caucasian man was admitted to Grant Hospital, Chicago, on November 26, 1956. He had been subject to recurrent episodes of abdominal cramps radiating to the lower part of the back, bloody diarrhea and an intermittent weight loss averaging 15 to 35 pounds. Appendectomy was performed in 1951; however, there was no change in the patient's symptoms following surgery. A gastrointestinal series revealed a "filling defect in the terminal portion of the ileum" in March 1956. At that time he noted that his abdomen became more distended and he was able to palpate a "tender mass" in the right upper quadrant of the abdomen. Exploratory laparotomy was performed and a carcinoid was diagnosed microscopically in March 1956. The carcinoid was located in the terminal portion of the ileum. Jejunoileostomy was performed with good temporary improvement, and there was a weight gain of 17 pounds. About six months after the operation the patient's abdomen became more distended than ever before, and he averaged 8 to 10 bloody bowel movements daily. Dyspnea and palpitation were noted and a "feeling of warmth" appeared regularly.

On physical examination the patient was very alert and appeared to be an intelligent Caucasian man, whose skin had a very noticeable "sun tanned" appearance, and whose muscles and subcutaneous tissues showed rather noticeable waste. There was no lymphadenopathy present. The lungs were clear, although he appeared to be somewhat dyspneic with 28 respirations per minute. The heart sounds were of good quality and the pulse rate was 92 per minute. No murmurs were heard. The aortic second sound was equal to the pulmonic second sound. The blood pressure was 120/80 mm. Hg. The abdomen was quite distended and slight ascites was present. There was a somewhat semi-solid tender mass (about 35 by 30 cm.) extending from the liver down to the McBurney scar. The extremities did not reveal any edema or deformities.

Roentgenograms of the chest disclosed the heart and lung fields to be within normal limits. An upper gastrointestinal series revealed no abnormalities; however, barium enema showed distinct changes in the terminal portion of ileum which consisted of "coarsening of mucosa and many adhesions." The possibility of an abscess in that area had to be considered, according to the radiologist.

Laboratory findings, which included the determination of alkaline phosphatase and serum protein levels, were normal except for a strongly positive reaction to the 5-hydroxy 3-indolacetic acid test and cephalin flocculation of 3 plus.

Surgery was performed on November 30, 1956. The entire small bowel was thickened and dilated from the jejunum down to the cecum. About 2 feet from the cecum a side-to-side anastomosis was found (the operation performed in March 1956). At the jejunum there was a mass in the mesocolon binding the jejunum as it crossed over the vertebra, probably producing an incomplete obstruction of the superior mesenteric vein; this resulted in an extremely marked venous distention and engorgement. Arterial vascularization was very pronounced making any surgical procedure impossible because of massive bleeding at the time of operation.

The patient's operative and postoperative course was marked with elevations in temperature and pulse rate (120 to 140 per minute); heart failure ensued. Blood pressure ranged between 90/60 to 110/70 mm. Hg. The administration of digitalis, oxygen and Benadryl® failed to produce any beneficial effects. The electrocardiogram revealed tachycardia of 130 per minute with counterclockwise rotation of the heart. (Fig. 1.) Therapy with cortisone acetate, 100 mg. twice a day, was started on December 3, 1957 (third postoperative day).

* Present address: 20th Station Hospital, U. S. Army, Nuremberg, Germany.

Following the second dose of cortisone, there was an improvement in the patient's condition. By the sixth postoperative day the patient was able to take oral feedings; his temperature, pulse rate and blood pressure were back to previous values. He was discharged on a regimen of ACTH gel, 40 mg., and prednisolone, 10 mg. daily.

A qualitative testing of urine revealed less positive reactions to tests for 5-hydroxy 3-indolacetic acid following cortisone and prednisone medication. The patient gained 25 pounds and stayed relatively well for about 5 months.

Four months later (April 5, 1957) the patient was readmitted with sudden nausea, vomiting, precordial pains radiating into his left arm, intermittent epigastric distress and marked weakness and sweating. At this time the patient did not have any evidence of edema or moon face; he was rather dehydrated and had frequent facial flushes. The pulse rate was 100 per minute, blood pressure 128/80 mm. Hg and respirations 26 and regular. The lungs revealed moist rales in both bases. There was a grade 2 systolic murmur over the apex. Aortic second sound was equal to pulmonic second sound. The heart was moderately enlarged to the left. The abdomen was soft and the tumor was somewhat smaller. The urine was positive for 5-hydroxy 3-indolacetic acid. Serum albumin was 1.91 gm. per cent (previously 4.75 gm. per cent) with an elevation of β-lipoproteins. Electrolytes were normal.

An electrocardiogram revealed coved ST with coronary T waves in all V leads and inverted T in leads II, III, AVF, and shortened QT intervals to 0.32 with a pulse rate of 68. (Fig. 1.) The previous electrocardiogram had been normal.

The patient was discharged following the administration of potassium chloride, ACTH and intravenous fluids.

The third and last hospitalization occurred six weeks later because of similar symptoms, although wheezing was present for the first time. The result of the test for 5-hydroxy 3-indolacetic acid in the urine was positive. An abdominal paracentesis resulted in the removal of 2,500 cc. of chylous fluid with no malignant cells present. The specific gravity was 1.010. A chest roentgenogram revealed discoid atelectasis in both bases. An electrocardiogram showed sinus arrhythmia with marked coronary insufficiency. The patient was started on a regimen of antiserotonin compound 45–50* which was given in an attempt to control symptoms of cor pulmonale. The compound was administered in increasing doses from 10 mg. three times a day to 30 mg. four times a day; however, its administration had to be stopped because of hypotension, tachycardia and poor visual acuity. Reinstitution of the compound caused symptoms to recur.

* Produced by Burroughs Wellcome & Co., Inc.

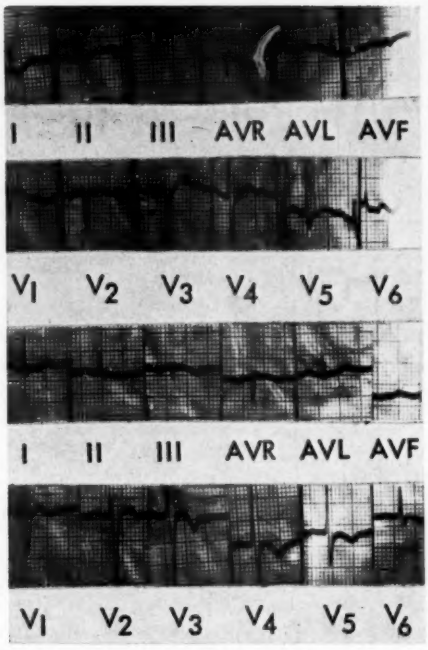


FIG. 1. Case 1. Electrocardiograms taken on December 3, 1956 (first tracing) and April 6, 1957 (second tracing). Second tracing shows marked ST segment changes: coved ST and negative T waves in all leads except leads I and AVF.

Two weeks later the patient died suddenly. No physical or postmortem examination was performed.

Comment: This forty-three year old male patient has suffered from malignant carcinoid for at least seven years. Appendectomy did not produce any relief of symptoms in 1951, and the diagnosis was only established in March 1956 during an exploratory laparotomy. The second operation was unsatisfactory because of an enormous vascularity in the mesocolon and mesojejunum, and marked dilatation of the superior mesenteric vein due to an incomplete obstruction by massive adhesions.

The patient almost died postoperatively; there was evidence of heart failure, tachycardia, cutaneous flushes, dyspnea, marked abdominal distention and elevations in temperature. The patient did not respond to the administration of digitalis, oxygen and Benadryl. Cortisone therapy produced dramatic clinical improvement within twenty-four hours.

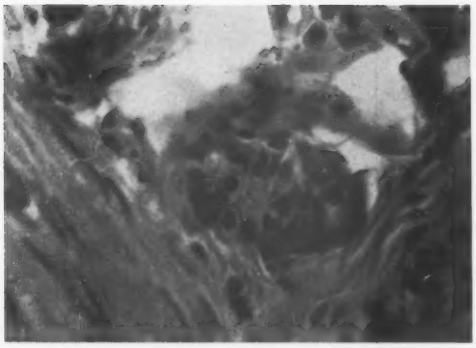


FIG. 2. Case II. One of numerous pseudorosettes present in the tumor. Note an amorphous material which is present within the center of the pseudorosette (ileum).

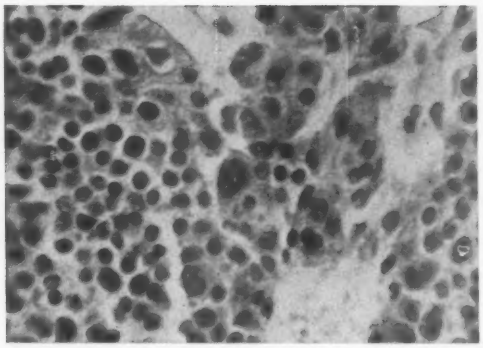


FIG. 3. The carcinoid cells from the primary tumor in the ileum showing small epitheloid cells with an oval or round nuclei that have well defined nuclear membranes and fine stippling of chromatin.

Cortisone was administered because: (1) There was a pronounced connective tissue reaction at the site of the carcinoid with extraordinary vascularity and vascular obstruction in the region of the superior mesenteric vein. It was thought that cortisone might arrest the fibroblastic reaction which is known to take place in the malignant carcinoid syndrome. (2) The patient had been weakened by chronic disease, and most likely represented a case of failing adrenals in face of poor adrenal blood supply, since too much collateral circulation to the jejunum, ileum, colon and adrenals was interrupted during surgery. Three blood transfusions were also required. (3) It was thought that cortisone might exert some beneficial, yet unknown, effect on the serotonin level directly.

The patient was asymptomatic in two days and from then on his hospital course was uneventful. At the time of the second admission there was some cardiac involvement. On the final admission (May 20, 1957) the patient had cardiac symptoms and wheezing. A grade 3 systolic murmur was heard over the apex. The patient was started on antiserotonin compound 45–50. Because of toxic symptoms the administration of the compound was discontinued.

CASE II. A forty-nine year old Caucasian man died on January 27, 1951 after an illness of about three years' duration, which was characterized by intermittent bloody diarrhea, pain in the right lower-upper quadrants of the abdomen and pronounced pellagrous changes in skin. An appendectomy had been performed in 1948. Because of the persistence of the abdominal pain the patient was admitted to the hospital on several occasions. Barium enemas and sigmoidoscopies failed to reveal any pathologic condition. Stool specimens for ovae and parasites were negative. Stool cultures and serum agglutination studies remained negative. Blood chemistry was within normal limits. The total protein was decreased to 2.0 gm. per cent. White blood cells were 7,800 per cu. mm.; red blood cells, 4.4 million per cu. mm.; hemoglobin, 15.0 gm. per cent; hematocrit, 42; sedimentation rate, 11 mm./one hour. Chest roentgenograms and gallbladder series revealed no abnormalities. Blood pressure was 118/70 mm. Hg. and the pulse rate 80 per minute in September 1955. There was no elevation in temperature. The urinalysis was within normal limits, not checked for 5-hydroxy 3-indolacetic acid. At that time the patient stated that he had had occasional erythematous flushing lasting for about three to five minutes. In spite of his good appetite, he had lost 15 pounds in weight during the last six months of his illness.

Postmortem examination revealed carcinoid tumor in the ileum with extensive metastases to the liver and to many peritoneal lymph nodes. A small carcinoid tumor was found in the duodenum. (Fig. 2.)

Comment: In retrospect, this patient presented a typical picture of malignant carcinoid syndrome; however, diagnosis was established only by means of postmortem examination. This patient also showed a marked depletion in serum albumin although the results of liver tests were normal.

OBSERVATIONS

Carcinoids, also referred to as argentaffinomas, arise from the chromaffin, Kulschitsky cells. These cells are scattered among the

mucuos-secreting lining in the crypts of Lieberkühn. Extra-appendiceal carcinoids possess pronounced malignant features. They produce an excessive amount of 5-hydroxytryptamine, serotonin, which is responsible for many typical manifestations encountered in a malignant case syndrome.

The typical carcinoid cell is a small epitheloid cell with an oval or round nucleus that has a well defined nuclear membrane and a fine stippling or chromatine. (Fig. 3.)

Most commonly carcinoids are found in the appendix and duodenum; they are relatively rare in the jejunum, ileum and large intestine, and occur only occasionally in the stomach. Some authors believe they have an endocrine function similar to that of the pancreas. Others believe they simply supply enzymes to the intestinal juice [15].

Metastasis to regional lymph nodes, liver, lungs, bones, spleen, kidneys, brain, abdomen, subcutaneous tissues and testes has been reported. The lymphatic spread is most common but there may be vascular invasion.

Serotonin or 5-hydroxytryptamine is formed by enzymatic hydroxylation and decarboxylation of the amino acid tryptophan. It is pharmacologically a very potent agent which is converted by an enzyme, mono-amine-oxydase, into a pharmacologically inactive compound called 5-hydroxy 3-indolacetic acid. The latter is excreted into the urine in quantities ranging from 2 to 7 mg. per twenty-four hours [10]. (Fig. 4.)

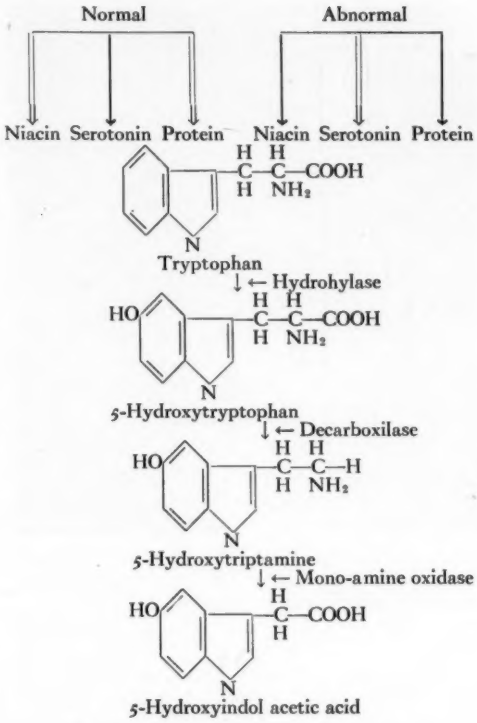


FIG. 4. Metabolic pathway of serotonin.

Serotonin is proved to be responsible for the appearance of rather typical functional and organic manifestations encountered in patients suffering from malignant carcinoids. These are as follows: (1) cutaneous flushes with blotchy cyanosis without any polycythemia, which also can be produced by the rapid intravenous administration of serotonin [4] (1.8 to 4.0 mg. serotonin); (2) biphasic blood pressure response: 0.5 to 2.0 mg. of serotonin injected produces a brief fall in blood pressure followed by an overshoot that lasts for 1 to 5 minutes with an increase in pulse rate [2]; (3) increase in the depth of respiration accompanied by subjective dyspnea, coughing and sometimes preceded by a short period of apnea [2]; (4) increased peristalsis due to stimulation of intestinal motor activity through cholinergic nerves at the site distal to the ganglionic synapsis with production of diarrhea and intestinal obstruction [14]; (5) increased pulmonary artery pressure and histologically demonstrable thickening of the pulmonary artery walls [13]; (6) bronchial constriction [13]; (7) pellagra-like cutaneous lesions [7]; (8) pulmonic stenosis and tricuspid insufficiency by means of "an active fibroblastosis" [13]; and (9) arthropathy.

High concentrations of serotonin may occur at special sites, e.g., in association with clotting of blood, where local high concentrations may be of pathologic and physiologic significance, causing very pronounced vasoconstriction. This is seen in the pulmonary embolism due to tissue and platelet destruction [18]. Furthermore, serotonin is found in the central nervous system and in the ganglia in relatively much greater quantities than acetylcholine, and it is believed that serotonin may be an important transmitter of nerve impulses in autonomic ganglia [5].

After administration of reserpine, brain cells seem to lose their power to retain serotonin

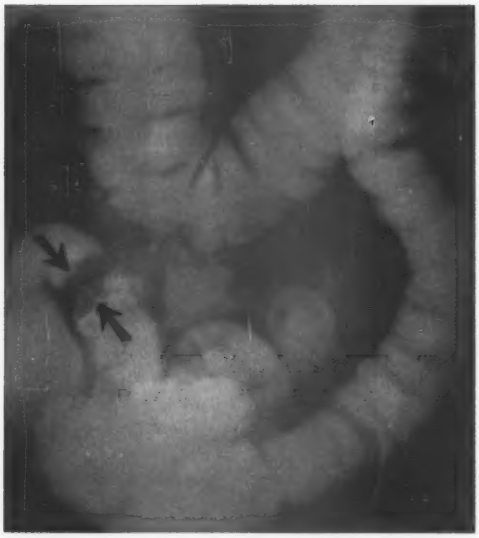


FIG. 5. Barium enema demonstrates an intrinsic lesion in the ileum (May 1959). This was proved to be the primary site of malignant carcinoid.

and after being released it is destroyed by mono-amine-oxydase. Platelet serotonin is not affected by the enzyme until liberated by platelet destruction.

Drugs investigated which are capable of affecting serotonin-induced symptoms are: (1) lysergic acid which blocks both the central and peripheral actions of serotonin; this compound causes schizophrenic-like mental disturbances [2]; (2) Thorazine® which antagonizes the cardiovascular actions of serotonin as well as decreases peristalsis induced by serotonin [5]; (3) neo-antigen and Benadryl which increase the pressor but not the depressor response induced by serotonin [2]; antihistaminics potentiate effects of serotonin on intestinal response [19]; (4) Regitine® which blocks only slight pressor response caused by serotonin [2]; (5) BAS which completely blocks pressor but not depressor response induced by serotonin [3]; (6) anticholinergic drugs which somewhat inhibit the effects of serotonin [19]; (7) Yohimbin and ergotamine which have some beneficial effect on the gastrointestinal tract and vascular components; (8) antiserotonin compound 45–50, used to treat our first patient, produced too marked a drop in blood pressure, an increase in pulse rate and severe visual disturbances when administered in doses of 120 mg. per day; these symptoms subsided promptly upon discontinuation of the drug.

SUMMARY

Two cases of malignant carcinoid syndrome are added to the literature.

In Case 1 the patient was actively treated with cortisone and prednisone, which produced dramatic improvement in the immediate postoperative period. Antiserotonin compound 45–50, which was used to control cor pulmonale, produced visual disturbances, drop in blood pressure and tachycardia and had to be discontinued.

The second case was not clinically recognized; however, in retrospect it represented a typical case of the malignant carcinoid syndrome. Both patients had very marked albumin depletion with normal reaction to liver function tests and pronounced pellagrous skin changes.

ADDENDUM

Since this manuscript was submitted, a third case of malignant carcinoid was diagnosed and treated by one of us in May 1959 (R. J. G., Grant Hospital).

The patient was a fifty-one year old Caucasian woman who, since about February 1959, complained of severe upper abdominal cramps, watery diarrhea, rapid abdominal distention which lasted from three to four days and occurred at two- to three-week intervals. With each abdominal crisis, there was an initial bilateral loin spasm and cramp which terrified the patient so that she hardly could breathe or move.

Surgery revealed a malignant carcinoid lesion in the ileum with metastasis to the regional lymph nodes. There was a positive reaction to the 5-hydroxy 3-indolacetic acid test only once and this occurred four weeks after surgery.

Following surgery, the patient's course has been difficult. She continues to have ten to fifteen watery bowel movements daily; these are controlled fairly well with chlorpromazine and prednisolone therapy. (Fig. 5.)

REFERENCES

1. DIFFENBAUGH, W. G. and ANDERSON, R. E. Carcinoid (argentaffin) tumors of the gastrointestinal tract. *Arch. Surg.*, 73: 21, 1956.

2. HOLLANDS, W., MICHELSON, A. S. and WILKINS, R. N. Serotonin and antiserotonins. I. Their circulatory, respiratory and renal effects in man. *Circulation*, 16: 246, 1957.
3. WILKINS, R. N. and HOLLANDER, W. Serotonin and antisterotonin. II. Clinical studies especially in essential hypertension with the benzyl analog of serotonin (b.a.s.). *Circulation*, 16: 256–263, 1957.
4. SCHENKLOTH, R., PAGE, I. H., DES GRECO, F. and CORCORAN, A. C. Effects of serotonin antagonists in normal subjects in patients with carcinoid tumors. *Circulation*, 16: 523, 1957.
5. PAGE, I. H. and MCCUBBIN, G. W. Serotonin or tenure for the pharmacologist. *Circulation*, 16: 161–162, 1956.
6. JENKINS, G. S. and BUTCHER, P. G. A. Malignant argentaffinoma with cyanosis and pulmonary stenosis. *Lancet*, 16: 331–333, 1955.
7. FEIN, S. B. and KNUDSON, K. P. The malignant carcinoid syndrome, a case report with biochemical studies. *Cancer*, 9: 148–151, 1956.
8. ERSPAMER, V. Pharmacology of indolealchylamines. *Pharmacol. Rev.*, 6: 425, 1954.
9. ERSPAMER, V. Serotonin (5-hydrotryptamine). *Physiol. Rev.*, 34: 563, 1954.
10. MCELROY, W. D. and GLASS, H. B. Editors. The 5-Hydroxyindole Pathway of Tryptophane Metabolism, in a Symposium on Amino Acid Metabolism, p. 945. Baltimore, 1955. Johns Hopkins Press.
11. HEILMEYER, L., KUEHN, H. A., CLOTTEN, R. and LIPP, A. Metastasierendes Duenndarmcarcinoid. *Deutsche med. Wchnschr.*, 81: 501–503, 1956.
12. LASHMUTT, R. E. and KOLOZSI, W. A. Carcinoid tumors (argentaffinomas) of the gastrointestinal tract: a report of 12 cases. *Gastroenterology*, 26: 743–753, 1954.
13. MACDONALD, R. A. Study of 356 carcinoids of the gastrointestinal tract. *Am. J. Med.*, 21: 867–877, 1956.
14. HAVERBECK, B. J., HOGBEN, C. A. H., MORAN, N. C. and TERRY, L. L. Effect of serotonin (5-hydroxytryptamine) and related compounds on gastric secretion and intestinal motility in dogs. *Gastroenterology*, 32: 1058, 1957.
15. HINES, M. O., HANLEY, P. H. and BOESE, H. L. Carcinoid tumors of the gastrointestinal tract. *Arch. Int. Med.*, 96: 500–505, 1955.
16. SEAMURHA, V. and WILES, C. E. Primary carcinoid of the duodenum: report of a case and review of literature. *Gastroenterology*, 26: 789–793, 1954.
17. MARTIN, J. D., JR. and ATKINS, E. C., JR. Carcinoid of the stomach. *Surgery*, 31: 698, 1952.
18. DAVIDSON, J., SJOERDSMA, A., LOOMIS, L. N. and UDENFRIEND, S. Studies with the serotonin precursor, 5-hydroxytryptophan in experimental animals and man. *J. Clin. Invest.*, 36: 1594–1599, 1957.
19. HENDRIX, T. R., ATKINSON, M., CLIFTON, J. A. and INGELFINGER, F. G. The effect of 5-hydroxytryptamine on intestinal motor function in man. *Am. J. Med.*, 23: 886, 1957.

False Aneurysm Due to an Infected Aortic Anastomosis

SUCCESSFUL RESECTION AND REANASTOMOSIS

C. BURLING ROESCH, M.D. AND JAMES W. BOND, M.D., *Jacksonville, Florida*

From the Baptist Memorial Hospital, Jacksonville, Florida.

THE conscientious surgeon is constantly mindful of the problem of postoperative infections. Any type of infection following an operation is distressing to both the surgeon and the patient, but following surgery on the great vessels it may be disastrous. Such a case is mute testimony that we must be constantly on guard against careless surgical technic in everyday practice. It has been stated many times, but is worth repeating, that the use of antibiotics, no matter how adequate the dosage, is no substitute for careful, meticulous, aseptic technic at the operating table. Attention to even the smallest and most routine detail is mandatory if one wishes to keep infection at a minimum. This report presents the case history of one patient in whom infection developed at the suture line following resection of a coarctated segment of the aorta. The suture line presumably represented either a nidus of infection or a site of lowered resistance to infection, which resulted in the development of a leak with consequent formation of a false aneurysm. Diagnosis and resection followed.

CASE REPORT

J. R. W., a twelve year old boy, was first seen by us in August 1956 with signs of coarctation of the aorta, diagnosed at the age of four years during a check-up for a contemplated tonsillectomy. The diagnosis was substantiated by a work-up at Johns Hopkins University Hospital. During the ensuing eight years the child was followed up periodically by his family physician, the only referable symptoms being occasional episodes of pain in the chest with radiation to the left arm, accompanied by numbness in the arm.

Upon initial examination, the boy appeared to be well developed and well nourished. He had a blood pressure of 160/80 mm. Hg in the right arm and 150/70 mm. Hg in the left arm. Very faint femoral pulsations were palpable bilaterally. He had a grade III systolic murmur at the cardiac apex and along the left sternal border, heard best in the third and fourth interspaces. When scheduled for surgery in June 1957, the blood pressure in the right arm was 160/100 mm. Hg, and in the left 150/80 mml Hg. His weight was 84 pounds.

Surgery was performed on June 10, 1957, at which time an hourglass coarctation of the aorta just distal to the ductus arteriosus was found, which was soft and collapsible; the diameter of the coarctation was approximately 4 mm. externally and 1 mm. internally. The aortic arch was 1.5 cm. in diameter, while the post-stenotic portion of the aorta was 6 cm. in diameter. Marked dilatation of the intercostal vessels and slight enlargement of the heart in the ventricular area were also noted. A 3 cm. segment of the aorta was resected, with anastomosis of the two ends, using a running No. 5-0 silk suture posteriorly and interrupted mattress sutures of No. 5-0 silk anteriorly. A few additional sutures were used to control small leaks which became apparent after removal of the clamps. The anastomotic line was protected with a sheet of Gelfoam,® and excellent pulsations were palpable in the distal aorta following release of the clamps. The anastomosis appeared to be of the same caliber as the remainder of the aorta.

The patient tolerated the operation very well and had a relatively uneventful postoperative course. Good femoral pulsations were noted daily. A low grade fever was present approximately five days following surgery, the temperature ranging from 99 to 100°F.; the last fever recorded was on June 17, the seventh postoperative day, at which time the temperature was 99.8°F. Penicillin, 400,000 units, was given immediately postoperatively and then every twelve hours for six days.

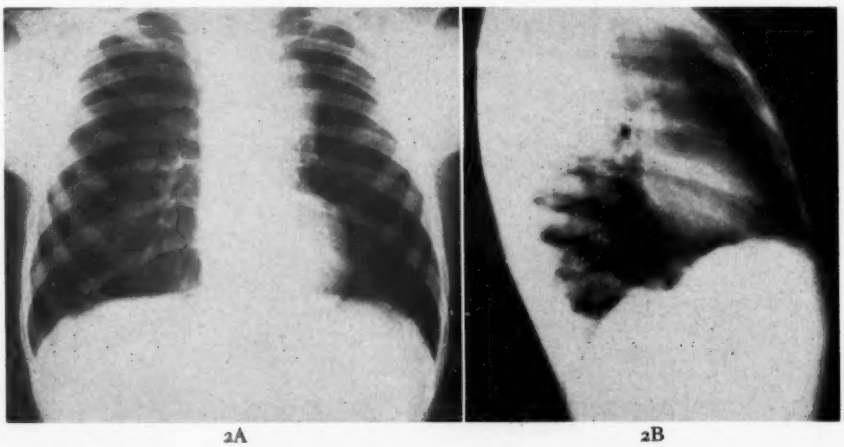
Crystalline penicillin was instilled into the thoracic cavity prior to the removal of the chest tubes.

The boy was discharged on June 19, the ninth postoperative day, with no fever and a blood pressure of 148/88 mm. Hg. A postoperative film of the chest is shown in Figure 1. He was followed up on routine postoperative visits, with no complaints or abnormal findings until July 2, 1957, at which time he had a temperature of 100°F., complained of headache and pain on the left side of the face, in the left hand, left side of the body and left leg. Sudden pain in the chest, left arm, neck and teeth developed after the patient had walked up an incline near his home on the previous day.

Examination revealed an apprehensive, petulant child with a red pharynx and red eardrums. Penicillin therapy was started but since the fever persisted, he was taken to the hospital on July 4, 1957. He continued to have a low fever for four days, when it suddenly spiked from 99 to 101°F., at which time the dose of penicillin was increased and erythromycin added. He was also given Alba-Penicillin® and strict bedrest was ordered. This was due to the fact that the mediastinal mass in the region of the left superior mediastinum, which was present on the film of the chest taken on July 4 (Fig. 2), had increased approximately two times in size from July 4 to July 8. (Fig. 3.) This mass was not present on the film taken June 25, 1957. (Fig. 1.) The x-ray shadow was thought to represent a false aneurysm, caused by the leakage of blood from an infected suture line. After a discussion with local surgeons and a personal communication from Dr. Alfred Blalock in Baltimore the decision was made to re-explore this patient.

The procedure was performed on July 10, 1957; the boy was afebrile and his general condition seemed satisfactory. At thoracotomy, a 10 cm. hematoma was present around the old suture line. A considerable amount of bleeding was encountered in the approach of the anastomosis, and it was necessary to control the hemorrhage by digital pressure until tapes could be passed around the aorta both proximally and distally. At this point the patient had a temporary episode of hypotension, but responded well to whole blood given through a preoperative venous cutdown. A second cutdown was performed at this juncture to insure adequate replacement of blood loss. After evacuating the hematoma the previous anastomosis was visualized, and a segment, approximately 3 cm. in length, was resected. Following this, another

FIG. 1. X-ray film taken fifteen days following the first operation.



2A 2B

FIG. 2. X-ray films taken twenty-seven days following the first operation. A, posteroanterior view. B, lateral view.

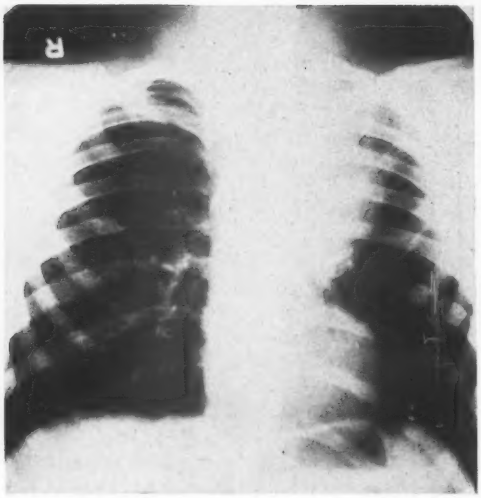


FIG. 3. X-ray film taken twenty-nine days following the first operation.

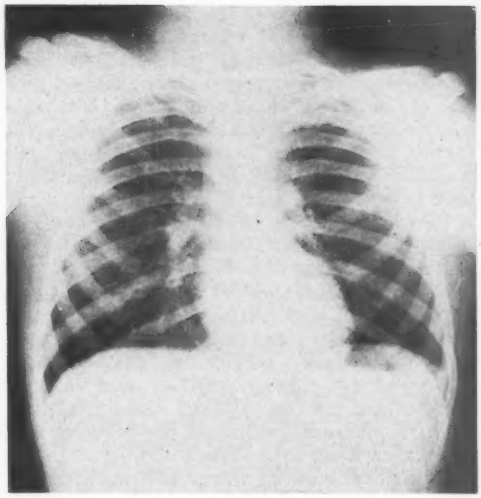


FIG. 4. X-ray film taken three months following the second operation.

anastomosis was performed, using the same technic and suture material as before. Several additional sutures were required to control a rather troublesome leak demonstrated after release of the distal clamp. The suture line was again protected with Gelfoam, and routine closure performed with the use of drainage tubes in the pleural cavity. During closure of the skin cardiac arrest developed, necessitating immediate opening of the thoracotomy wound and a brief cardiac massage. Regular rhythm was restored within a two-minute period, and no further difficulty was encountered; the period of actual massage was approximately thirty seconds.

The postoperative course was somewhat more stormy than the preceding one, but, in general, the patient did very well and was discharged on the twelfth postoperative day. Postoperative antibiotic therapy consisted of Terramycin® administered intravenously, 1 gm. daily for two days; Chloromycetin,® 500 mg. administered intramuscularly every six hours; and the addition of erythromycin on the second postoperative day in doses of 200 mg. every four hours. Chloromycetin was discontinued after four days and erythromycin continued until discharge. Seven days postoperatively mild diarrhea occurred which was thought to be a result of antibiotic therapy, but which responded well to administration of nystatin and Lactinex.® Cultures obtained from the infected suture line revealed the presence of a hemolytic Staphylococcus albus, reported as being highly sensitive to novobiocin and erythromycin but resistant to Terramycin, tetracycline, Chloromycetin, penicillin and dihydrostreptomycin. The postoperative blood pressure has been in the range of 120/70 to 140/50 mm. Hg. The boy was maintained on erythromycin daily as prophylactic therapy for four months.

His postoperative course to date has been uncomplicated. At the time of writing, he still has a systolic murmur heard best in the third and fourth left interspaces, and less distinctly at the apex, which is somewhat less pronounced than preoperatively. He is healthy and in good general condition. A film of the chest taken three months after the second operation is shown in Figure 4.

COMMENTS

Although there have been several reports of a staphylococcal infection following surgery around the heart and great vessels [*1–6*], we have been unable to find a report of successful treatment of such a complication following aortic resection for coarctation. Most cases occurred in patients who had a recurrence of a patent ductus, in many of whom silk sutures were found in a false aneurysm at the recurrent site [*2–6*].

The infection in this patient apparently occurred at a point of lowered resistance in the vascular system, subsequent to a bacteremia from an infection in the upper respiratory tract or ear. Bahnson and associates, in a recent article [*1*] reporting five cases of staphylococcal infection following operations on the heart and great vessels, postulated that the most likely cause of infection was contamination of suture material at the time of operation. In a recent

study, conducted at one of the hospitals in this city, Staphylococcus aureus was cultured from such sites as the spout of the soap dispenser on the scrub basins, in the scrub basins themselves, and at the equipment table in the operating rooms.

Although it may be necessary to revise our present opinions about the use of suture material for anastomosis of blood vessels, we believe that at the present time we should pay more attention to the sources of contamination in the operating theater, such as (1) the air conditioning system, (2) dirty linens, (3) student nurses, interns and other inexperienced personnel, (4) improper gowning (especially in the case of pathologists or other persons entering the operating suite in street clothes), (5) vigorous powdering of the hands near instruments or sterile equipment, (6) delay in changing gloves or gowns when any known or suspected contamination has occurred, (7) not using two masks when upper respiratory tract infections or infected facial lesions are present, and (8) unnecessary conversation and inconstant attention to most routine and minute details. Great care must also be exercised in the proper and selective use of antibiotics, with judicious use of cultures when feasible and constant awareness of the increasingly complex problem of resistant microorganisms.

Bahnson and his group [1] have recently conducted studies using silk, stainless steel, nylon, dacron and catgut sutures implanted in the right ventricular myocardium of dogs. They were interested to note that infections associated with catgut subsided regularly and healed spontaneously after three weeks, which they presumed to be due to the gradual absorption of the foreign body. They were not ready, however, to recommend the use of catgut sutures in cardiovascular surgery.

SUMMARY

A case of staphylococcal infection of an aortic suture line, with development of a leak and false aneurysm, is presented. Successful treatment of such a complication has not been reported in the literature to our knowledge. Several observations have been made about the need for constant vigilance on the part of all surgeons during any operation.

It is imperative to use all possible precautions to prevent the potentially disastrous complication of infected suture lines in cardiovascular surgery.

REFERENCES

1. Bahnson, H. T., Spencer, F. C. and Bennett, I. L., Jr. Staphylococcal infections of the heart and great vessels due to silk sutures. *Ann. Surg.*, 146: 399, 1957.
2. Ekstom, G. The surgical treatment of patent ductus arteriosus. *Acta chir. Scandinav.*, Suppl. 169, 1952.
3. Jones, J. C. Complications of the surgery of patent ductus arteriosus. *J. Thoracic Surg.*, 16: 305, 1947.
4. Scott, H. W. Surgical treatment of patent ductus arteriosus in childhood. *S. Clin. North America*, 32: 1299, 1952.
5. Touroff, A. S. W. Discussion of article by Jones, J. C. [3].
6. Touroff, A. S. W. Discussion of article by Gross, R. E. Complete division for patent ductus arteriosus. *J. Thoracic Surg.*, 16: 324, 1947.
7. Shumacker, H. B., Jr. and King, H. Surgical management of rapidly expanding intrathoracic pulsating hematomas. *Surg., Gynec. & Obst.*, 109: 155–164, 1959.

Metastatic Melanoma of the Stomach

GALEN H. DAVIS, M.D. AND RICHARD W. ZOLLINGER, M.D., *Columbus, Ohio*

From the Departments of Surgery and Pathology, The Medical Center, Ohio State University; and the Mount Carmel Hospital, Columbus, Ohio.

METASTATIC melanoma is well known for its myriad manifestations. As such, it is not unusual for various organ systems to be involved, particularly in terminal states. The gastrointestinal tract however, is rarely attacked, according to Willis' observations [*1*]. Willis also states that metastasis to the stomach is very rare indeed.

Recently, a case of melanoma metastatic to the stomach was observed. This case, in addition to the foregoing statement, prompted a review of similar cases (at University and Mount Carmel Hospitals, Columbus, Ohio). The purpose of this survey was to determine the relative frequency of such lesions, as well as to find the common characteristics, if any, that would prove useful in diagnosis.

CASE REPORT

E. C. (No. 11820L) was a seventy-six year old white woman who was admitted to the Mount Carmel Hospital with a six-month history of epigastric discomfort and postprandial pain. In addition, there had been a weight loss of twelve pounds, anorexia, nausea and frequent tarry stools. Also noted was a feeling of weakness which was more marked in the morning hours. Roentgenological evaluation in the weeks preceding admission had shown a large, polypoid mass in the fundus of the stomach which was reported as showing an extensive filling defect involving the upper two-thirds of the stomach, due to a neoplasm. The impression was that the patient had carcinoma of the stomach. (Fig. 1.) The esophagus and duodenum were normal in appearance. A film of the chest was reported as not disclosing any demonstrable abnormalities. The patient was subsequently admitted to Mount Carmel Hospital on September 4, 1957, for further evaluation and possible treatment.

In the past, the patient had noted a dark, pigmented mole on the posterior aspect of the left upper arm which had been present for at least fifteen years. Following a two-month period of intermittent bleeding from this area, she consulted a physician who recommended that a biopsy specimen be taken. She was subsequently admitted to University Hospital (No. 577879) on November 27, 1955, where biopsy of the lesion revealed a malignant melanoma. Wide excision of the primary tumor, together with a radical axillary dissection, was performed. No tumor was found in any of the sugical specimens from the axilla.

The patient was discharged on December 7, 1955, following an uncomplicated hospital course, with instruction to return at frequent intervals for check-ups.

The review of systems did not produce additional pertinent information.

Physical examination showed a moderately underweight, elderly, white woman, who appeared chronically ill. There were well healed scars of the left axilla and left upper arm. Minimal edema, with a questionable small lymph node, was noted in the left axilla. A firm, non-tender liver edge was felt 4.5 cm. below the right costal margin. No other masses or organamegaly was detected. The remainder of the physical examination was essentially within normal limits.

Laboratory studies on admission showed a hemoglobin content of 11.8 gm. per cent, white blood cell count 9,050 per cu. mm., with a moderate shift to the left in the differential count. The urinalysis was negative for abnormalities. Fasting blood sugar was 93 mg. per cent. The blood urea nitrogen was 5.0 mg. per cent. The prothrombin time was 95 per cent normal. Total proteins were 6.76 gm. per cent. Determination of blood volume revealed a reduced total volume of 990 cu. cm.; deficit of plasma volume, 520 cu. cm.; and a depletion of red cell volume, 470 cu. cm. The serum electrolytes and carbon dioxide combining power were within acceptable limits. Twelve-hour gastric analysis was reported as having a total volume of 16 cu. cm. with no free hydrochloric acid. Total gastric acidity was 5.0 degrees.

On September 9, 1957, following a preparatory period, the abdominal cavity was entered through a left paramedian rectus incision. The stomach, small intestine and remainder of the abdominal contents were inspected. The stomach was found to be small. A tiny, black, pin-head sized area was noted on the anterior surface. Other similar areas

were discovered throughout the gastrocolic omentum. Palpation of the stomach demonstrated several small, freely movable masses within its lumen which were believed to be polypoid in nature. No gross abnormality of the liver was detected. The gallbladder contained many small stones. Gastrotomy was performed. Inspection of the mucosa resulted in discovery of several mushroom-shaped lesions (with centrally located ulceration in many), concentrated in the fundus of the stomach. (Fig. 2.) Solitary lesions of similar character were found scattered throughout other areas of the stomach. The gross appearance of melanoma was confirmed by microscopic examination of multiple biopsy specimens. In view of the inoperability, the stomach and abdomen were closed.

The immediate postoperative period was satisfactory. However, the patient's condition gradually deteriorated. On September 28, 1957, an obvious superficial thrombophlebitis of the right long saphenous vein developed, which in view of the patient's poor prognosis, was treated conservatively. On October 8, 1957, acute respiratory distress suddenly developed and the patient died. The immediate cause of death was determined to be due to pulmonary embolization.

At necropsy, multiple polypoid lesions, varying from 1 to 2 cm. in diameter, were found concentrated along the greater curvature of the stomach. The gross and microscopic appearance was that of melanoma. A 5 mm. submucosal nodule of tumor was encountered in the mid-jejunum. In the large bowel, two slightly polypoid nodules were found, one in the cecum and the second in the transverse colon. Multiple tumor nodules were scattered throughout the peripancreatic fat, the largest of which was 15 mm. in diameter. Also, a 3 cm. tumor nodule was discovered in the cortex of the left adrenal. Multiple sections through the myocardium disclosed a solitary 3 mm. area of tumor in the wall of the left ventricle. Palpation of the lungs revealed several nodules of tumor, less than 0.5 cm. in diameter, which microscopically were typical of metastatic melanoma. Thrombi were found in medium-sized arteries supplying the right lower lobe. The liver was of normal size and on sectioning demonstrated only two 10 to 12 mm. sized nodules of metastatic tumor. The gallbladder contained numerous small calculi.

FIG. 1. Radiologic appearance of the mass located in the fundus of the stomach. Note the polypoid character.

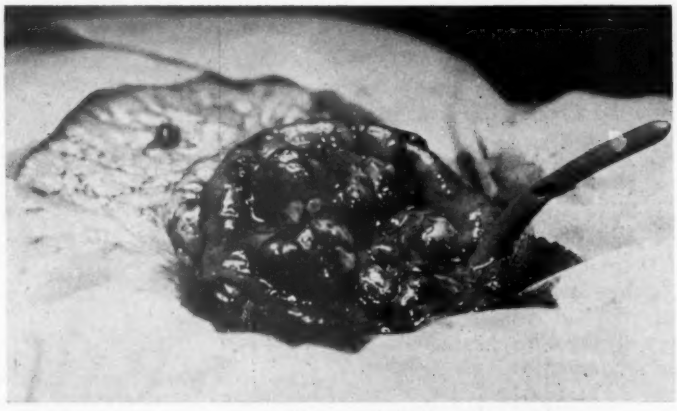


FIG. 2. Gross appearance of the gastric lesions at time of surgery.

TABLE 1
OCCURRENCE OF METASTASES TO THE STOMACH FROM MALIGNANCY ARISING OUTSIDE THE GASTROINTESTINAL TRACT*

Neoplasm	No. of Cases
Bronchogenic carcinoma	10
Reticulum cell sarcoma	7
Carcinoma of pancreas	7
Carcinoma of prostate	4
Lymphosarcoma	4
Hepatoma	3
Carcinoma of ovary	3
Carcinoma of cervix	3
Carcinoma of breast	3
Melanoma	3
Endometrial adenocarcinoma	2
Carcinoma of gallbladder	2
Lymphoblastoma	2
Fibrosarcoma of uterus	2
Carcinoma of tongue	1
Carcinoma of bile duct	1
Carcinoma of thyroid	1
Carcinoma of urinary bladder	1
Carcinoma of esophagus	1
Carcinoma of cystic duct	1
Carcinoma of testis	1
Fibrosarcoma of lip	1
Chordoma	1
Choriocarcinoma	1
Chronic lymphatic leukemia	1
Adenocarcinoma of colon	1
Total	67

* 23,019 autopsies.

COMMENTS

Three additional cases of melanoma, metastatic to the stomach, were found by review of the operative and autopsy statistics encompassing a twenty-year period (1937–1957). The relative occurrence of melanoma, metastatic to the stomach, as compared to other types of malignancy involving the gastrium, is depicted in Table 1. Instances of contiguous spread were not included. From these results, the approximate incidence of melanoma metastatic to the stomach found at autopsy, was one case in 7,000 postmortem examinations.

A total of 134 cases of cutaneous and ocular melanoma were reviewed. No instance of gastric involvement from ocular melanoma was found; however, such is known to occur [2].

Probably the greatest aid in the diagnosis of such lesions, short of direct visualization and biopsy, is radiologic examination. It is said that the polypoid appearance of the lesion is of particular importance. This is believed to represent a constant pattern of gastric metastasis from melanoma [3,4], although polypoid lesions of the stomach are not exclusively a feature of melanoma [5].

Frequently, evidence of central ulceration, giving the appearance of a "donut" shaped area, may be seen [6–8]. In this regard, Willis states that pure metastasis occurs by the hematogenous route. He describes the formation of a doughnut-shaped lesion as beginning with submucosal invasion, which progresses to the development of a circumscribed nodule or plaque that protrudes into the lumen and eventually undergoes central ulceration. Barium studies, in such cases, generally reveal a circumscribed filling defect, with a centrally located area of opaqueness. Calcification in metastatic lesions has also been reported [9].

Other measures, such as gastroscopy which occasionally permits direct visualization and biopsy, or gastric lavage and microscopic examination of the obtained cells, may prove useful in certain instances.

SUMMARY

A case of cutaneous melanoma, metastatic to the stomach is described. Similar cases over a twenty-year period were reviewed. The frequency of gastric involvement by metastasis from melanoma was one in 7,000 autopsies and one in forty-five cases of melanoma. A description of the lesions encountered is given, together with an analysis of methods useful in their diagnosis.

REFERENCES

1. WILLIS, R. A. The Spread of Tumors in the Human Body. 2nd ed. London, 1952. Butterworth and Co.
2. Clinicopathological conference. Ocular melanoma metastatic to the stomach. *Postgrad. Med.*, 22: 183, 1957.
3. RICHMAN, A. and LINSAY, J. Melanoma of small intestine and stomach. *J. Mt. Sinai Hosp.*, 17: 907, 1951.
4. CHALDRON, R., CEBALLOS, J. and MCGRAW, J. Metastatic melanoma of the stomach. *Am. J. Roentgenol.*, 74: 242, 1955.
5. HIGGINS, G. A. Polypoid lesions of the stomach. *Am. Surgeon*, 21: 318, 1955.
6. HILBISH, T. F. Roentgen manifestations of malignant melanoma. *Am. J. Roentgenol.*, 78: 769, 1957.
7. KUKES, J. Melanoblastic gastric ulcer. *Lékařské listy*, 9: 184, 1954.
8. LUDIN, H. Melanoma metastasis in stomach and duodenal bulb. *Oncologia*, 6: 221, 1953.
9. ESCOVITZ, W. and WHITE, S. G. Extensive metastatic calcification in a case of malignant melanoma. *Ann. West. Med. & Surg.*, 40: 339, 1950.

Dermatofibrosarcoma Protuberans

J. K. McGregor, M.D., *Buffalo, New York*

Dermatofibrosarcoma protuberans is a neoplasm which originates in connective tissue. It was first described by Pliffard, but differentiated from other sarcomas of the skin by Darier [1] and Ferrande in 1929, and named by Hoffmann [2]. It is of interest because of its constant and characteristic clinical features which make diagnosis simple, and which differentiate it from other sarcomas of soft tissue.

The tumor usually occurs in persons between the ages of twenty and forty-five, but has been described in a child five years old [3]. The sexes are more or less equally represented with a slight preponderance in the female. It occurs most frequently on the anterior surface of the body to the right or left of the midline, with the periumbilical and groin regions predominating. The back, limbs, buttocks and genitalia, however, may also be involved [4].

CLINICAL APPEARANCE

Clinically the lesion may be irregular in contour, and rubbery and firm on palpation. It consists of a slightly raised mass with the bluish pink sclerotic appearance of a scleroderma. In the center, nodules of varying sizes appear to coalesce, forming a continuous plaque. This lesion is firmly fixed to the skin. It is freely movable over the deeper structures, except in its late stages when it may be fixed to deep fascial planes. After a variable, but usually long, period there appear on the plaque a number of nodules of varying sizes, either sessile or pedunculated which, in contradistinction to the slow growth of the early sclerotic plaque, increase rapidly in size, often becoming as large as a small orange within a few months. They may be whitish or, more characteristically, purplish in color, and are generally firm and rubbery on palpation but may become infarcted, cystic and necrotic. Ulceration may take place on the surface of the tumor, giving it a fungating appearance. Some may spontaneously involute and others drop off. The underlying plaque, however, spreads laterally and much more slowly into the deeper tissues, where it may become fixed to deep fascial structures. This accounts for the difficulty encountered in complete removal and in the local recurrence which follows about 20 per cent of surgical excisions. Finally the whole chest or abdomen may become covered with the growth.

Generally the condition is practically asymptomatic and does not affect the general health. Metastases are rare [5] but have been reported by way of lymphatics [4], either after the condition has been present for a long time [6], or after inadequate local excision [3,7].

The relation which this tumor has to the skin is sometimes simulated by wens which are generally less firm on palpation. Similarly, lipomas are usually easily recognized by their soft texture. Gummas of the back may be attached to the skin and discoloration may precede rupture, but they lack the encapsulation and their duration is shorter. Because of their reddish surfaces they have been mistaken for angiomas, but considering the difference in density of the two tumors the differentiation is not difficult. The so-called fibroid of Paget [8], or desmoid tumor, has sometimes been confused with this lesion; however, this is found most frequently in multiparous women and is attached to the deep fascia.

SITE OF ORIGIN

The site of origin of this sarcoma, although discussed by a number of authorities, is not as yet clearly established. Many believe that these tumors originate from the deep subcutaneous fibrous tissue of fat or fascia. Binkley [4] suggested the mammary ridge as a site of origin but admitted that it could not be explained on this basis alone. Others have postulated an origin in nerve tissue but no histologic proof of

FIG. 1. Clinical photograph shows large sessile and pedunculated tumor masses originating from a raised sclerotic skin plaque.

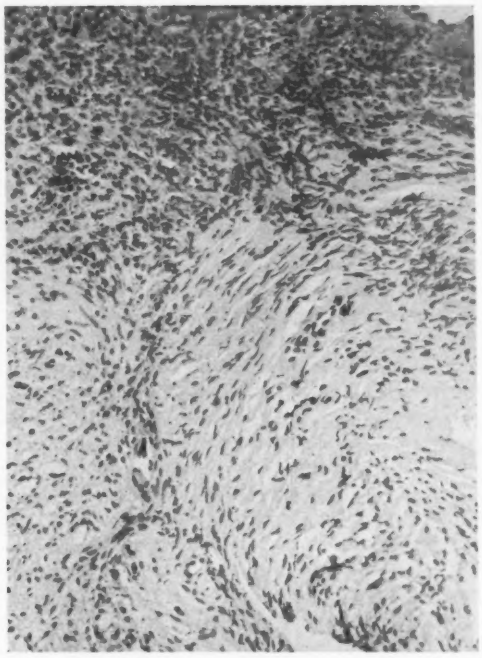


FIG. 2. Photomicrograph shows intertwining bundles of spindle cells, some of which show differentiation in size, shape and staining characteristics. (Courtesy of Dr. A. Lukas, Department of Pathology, Buffalo General Hospital, Buffalo, New York.)

this has been offered. Previous trauma has also been implicated as an etiologic factor but this is not clearly substantiated.

PATHOLOGY

Grossly these tumors are completely encapsulated except over the surface where the skin is attached to the tumor [*9,10*]. They are firm, dense and elastic on palpation. The cut surface shows wavy bundles of fibrous tissue more or less parallel with each other. The cut surface glistens and is pearly white or pinkish in color.

Microscopic examination reveals no features that might be regarded as pathognomonic. The epidermal layer is normal except for attenuation and loss of rete pegs. The corium is occupied by a uniform layer of myxedematous connective tissue with large lacunar spaces. Beneath this layer is a stratum composed of intertwining bundles of spindle cells with a few interspersed mitotic figures which penetrate the normal adipose tissue underlying the deepest portion of the growth. It is impossible to make the diagnosis from the histologic picture, even to distinguish it from other fibrosarcomas of the skin [*11*]. The diagnosis, therefore, must be based entirely on clinical grounds.

In recurrent tumors or those which have been attenuated by treatment, the cells may be a little broader and occupy the larger part of the field at the expense of the connective tissue, and the blood vessels are a little more in evidence. In areas of invasion and in the metastatic nodules, the tumor retains its fibrotic character.

TREATMENT

The method of treatment most widely accepted today is that of wide surgical excision [*12,13*]. If this is adequately executed an excellent prognosis can be expected. In some centers small plaque-like fibrosarcomas of skin may be treated initially by x-ray radiation. However, this mode of therapy is not applicable to the large bulky lesions such as in the case reported herein. When roentgen therapy is used it is based upon protected, high voltage, heavy filtration, low intensity technics. The applica-

tion of chemotherapeutic agents in the management of this tumor does not seem applicable in the light of present knowledge.

CASE REPORT

A thirty-three year old Negro nurse's aide presented with an eleven-year history of a large, rubbery, firm mass surrounded by several small, hard, painless nodules which were reddish or bluish pink in color and located on the upper, outer quadrant of the left breast. This lesion appeared to arise from a similarly colored sclerotic plaque which grossly resembled a keloid formation. This lesion was originally painful and had been treated by manipulation by a faith healer, who finally resorted to local excision. Subsequently the tumor recurred and was associated with several satellite nodules. Although the new lesion was not painful, it had a tendency to ulcerate. Secondary infection of the ulcer was not uncommon, and the patient was obliged to keep the lesion continually dressed to prevent soiling of her underclothing. Episodes of frank hemorrhage were reported to have occurred from time to time but these were controlled by pressure.

Physical examination revealed a Negro woman of approximately the stated age, in no apparent distress. Examination of her neck revealed a number of movable, firm, non-tender nodules in the left supraclavicular fossa. The chest expanded normally, and percussion and auscultation indicated no abnormalities. The left axilla revealed a few non-tender shotty nodules but was otherwise normal on palpation. The right breast and axilla showed no abnormality. On the left breast there was a mass the size of an orange located in the skin of the upper outer quadrant, surrounded by a number of smaller satellite nodules. (Fig. 1.) These masses appeared to originate from a bluish pink, raised, sclerotic plaque, which was firmly fixed to the skin but was freely movable over the subcutaneous structures. The remainder of the physical examination was non-contributory.

This lesion was biopsied and reported as a fibrosarcoma of the skin, compatible with a dermatofibrosarcoma protuberans. (Fig. 2.) The lesion was then widely excised, dissection being carried down to pectoral fascia. The defect was closed using split-thickness skin grafts.

The patient was seen some eight months later and noted to be progressing satisfactorily. The wound was well healed and no evidence of recurrence could be detected. The supraclavicular and axillary nodes were not detected at this time.

SUMMARY

The literature concerning dermatofibrosarcoma protuberans is briefly reviewed. The means of accurate clinical recognition and treatment are discussed, and a case report is presented.

CONCLUSIONS

1. These tumors are slow growing fibrosarcomas.
2. They are difficult to differentiate histologically from other types of fibrosarcomas of the skin but present a typical clinical picture.
3. They generally grow in continuity but may metastasize via the lymphatics.
4. A properly performed local operation results in a permanent cure in most instances.

REFERENCES

1. Darier, J. Progressive and recurring dermatofibromas. *Ann. de dermat. et syph.*, 5: 545, 1924.
2. Hoffmann, E. Knobby fibrosarcoma of the skin. *Dermat. Ztschr.*, 43: 1, 1925.
3. Aird, I. Companion in Surgery Study. Edinburgh, 1957. E. & S. Livingstone, Ltd.
4. Binkley, G. W. Dermatofibrosarcoma protuberans; report of six cases. *Arch. Dermat. & Syph.*, 40: 578, 1939.
5. Penner, D. W. Metastasizing dermatofibrosarcoma protuberans; a case report. *Cancer*, 4: 1083, 1951.
6. Bezecny, R. Lungenmetastasen beim Dermatofibrosarcoma Protuberans. *Arch. f. Dermat. u. Syph.*, 169: 347, 1933.
7. Hertzler, A. E. Fibrosarcoma tumors of skin of trunk characterized by attenuated dermal surfaces. *Ann. Surg.*, 84: 489, 1926.
8. Stewart, M. J. and Mouat, T. B. Fibroma of abdominal wall. *Brit. J. Surg.*, 12: 355, 1924.
9. Pillsbury, D. M., Shelly, W. B. and Kligman, A. M. Dermatology. Philadelphia, 1956. W. B. Saunders Co.
10. Sutton, R. L. and Sutton, R. L., Jr. Diseases of the Skin. St. Louis, 1953. C. V. Mosby Co.
11. Ackerman, L. V. Surgical Pathology. St. Louis, 1953. C. V. Mosby Co.
12. Borrie, P. Dermatofibrosarcoma protuberans. *Brit. J. Surg.*, 39: 452, 1952.
13. Jayes, P. H. and Dale, R. H. Sarcoma following x-ray therapy for Graves' disease. *Brit. J. Plast. Surg.*, 4: 147, 1951.

Huge Hiatal Hernia Associated with Acute Coronary Thrombosis

ANGELO RIBERI, M.D. AND ROBERT J. HRITZO, M.D., *Youngstown, Ohio*

From the Departments of Surgery and Pathology, St. Elizabeth Hospital, Youngstown, Ohio. This paper was one of the hospital prize winners in the 1958 contest sponsored by the Cleveland Area Surgical Society.

MUCH has been written about esophageal hiatal hernias and their role in producing cardiac symptoms. The patient on whom we are reporting presented with an unusual condition in which a huge hiatal hernia may have, directly or indirectly, produced a coronary thrombosis that resulted in a fatal myocardial infarction.

CASE REPORT*

A sixty-five year old white man was admitted to St. Elizabeth Hospital complaining of acute abdominal pain of three days' duration and persistent vomiting of two days' duration. There was no history of previous episodes of pain or indigestion suggestive of hiatal hernia. Physical findings were within normal limits, except for signs of minimal dehydration and a moderately distended abdomen with a "poorly defined mass" in the right upper and lower quandrants. The hemoglobin was 16 gm. per 100 ml., and the white blood cell count was 14,300 per cu. mm. with 85 per cent neutrophils. A flat film of the abdomen taken on the day of admission did not reveal evidence of bowel obstruction. A film of the chest disclosed no abnormalities. A Levin tube was inserted for nasogastric suction, and intravenous fluids were given to maintain a satisfactory electrolyte and fluid balance. Fluid and gastric suction was continued for three days, and the patient appeared somewhat improved. At this point a gastrointestinal series was undertaken. Shortly after the patient had swallowed 10 ounces of liquid barium sulfate and the first films were taken, he suddenly gasped and died. The films obtained antemortem showed a markedly distended small bowel and an intrathoracic stomach that pushed the heart forward against the sternum. (Figs. 1 and 2.)

*Reported through the courtesy of Dr. M. C. Raupple.

At autopsy, strangulated small intestine was found in an externally undetectable, right Richter's type femoral hernia. Proximal to the obstruction the bowel was markedly distended and red-purple in color. A sliding esophageal hiatal hernia was present measuring about 10 cm. in its greatest diameter. The major portion of the stomach projected through the hernia into an incomplete serous sac posterior to the heart and anterior to the thoracic aorta. The esophagus was of normal caliber and length. The stomach was dilated to two to three times its normal size. The right main stem coronary artery was completely occluded close to its origin by a brownish adherent thrombus. Near the apex, in the interventricular septum, there was a brownish tan discoloration which obliterated the normal bundle markings. The remainder of the heart and coronary arteries showed only moderate atherosclerosis. On microscopic examination it was noted that the thrombus was attacked by early organization, and the infarct showed necrosis and granulocytic exudate compatible with an infarct of some twelve hours' duration.

COMMENTS

The role of hiatal hernia in producing cardiac symptoms has interested many nvestigators. Von Bergmann in 1932 [1], and Harrington in 1933 [2] and 1938 [3] indicated that these hernias were associated with symptoms that simulated angina pectoris. Further interest in this problem was created by Gilbert. He found eighteen hiatal hernias in forty-four patients suffering from typical attacks of angina pectoris [7]. According to Salzberg and Blades, it is often possible to demonstrate in these patients electrocardiographic signs suggesting coronary artery disease accompanied by typical precordial pain and concomitant tachycardia [4].

Sweet, in analyzing a series of 130 cases of hiatal hernia [5] treated surgically, found thirty-two patients in whom the diagnosis of

FIG. 1. Anteroposterior roentgenogram of chest, with barium in stomach, shows extensive herniation of stomach into chest. A definite fluid level is seen.

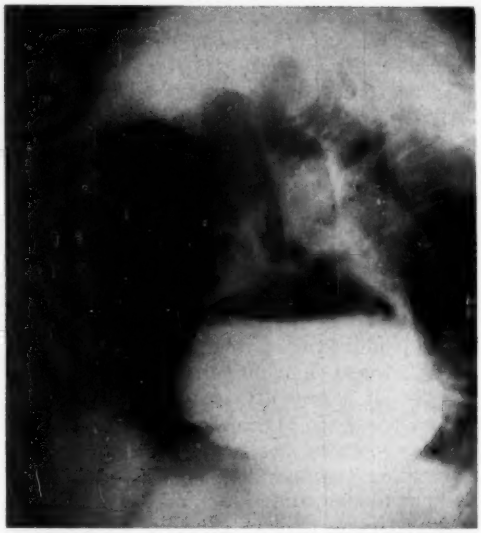


FIG. 2. Lateral view of chest. Location of herniated stomach is evident and displacement of heart against sternum is easily visible.

angina pectoris had been debated prior to surgery.

Jones and Chapman [6] were able to demonstrate that it was possible to elicit retrosternal pain with radiation toward the left arm by simply distending the lower esophagus of perfectly normal young adults with a balloon.

An interesting experiment was described by Gilbert et al. [7]: distention of the stomach or the peritoneal cavity in dogs produced a definite reduction in blood flow through the left circumflex coronary artery. Because this reduction in flow could be suppressed by vagotomy or by the administration of atropine, it was suggested that the anginal attacks occurring in hiatal hernia are not only angina-like but also true angina pectoris.

Holoubeck and co-workers [8] reported on twenty-one patients who had been treated for various lengths of time for coronary artery disease while the painful symptomatology was actually produced by diaphragmatic hernia. According to these authors, the electrocardiographic tracings in these patients showed a transient low T wave voltage in lead I. It seems significant that this alteration did not appear with exercise and did not recur after corrective surgery of the lesion.

A very pertinent study is that of Palmer [9] who made interesting observations on a group of 214 patients with hiatal hernia. Among them he found eleven patients with the classic manifestations of myocardial infection. In addition, several other patients had symptoms suggestive of coronary artery disease. This painful symptomatology was attributed to an autonomic reflex initiated by the displaced gastric pouch. Moreover, according to Palmer, nitroglycerine not only relieves the pain of angina pectoris but also often affords relief for the pain of hiatal hernia and other types of esophageal dyskinesias.

On the other hand, Master and associates [10] do not believe that simple hiatal hernia can produce disturbances of the coronary circulation if the coronary arteries are not diseased. However, they agree that angina pectoris can be precipitated by hiatal hernia when the coronary arteries are sclerotic, this being probably due to a trigger mechanism similar to that occurring in gallbladder disease as demonstrated by Ravdin.

Morrison and Schwalm [11] believe that the angina-like pain occurring in patients with hiatal hernia originates in the stomach and esophagus. These authors were able to produce experimentally sudden changes in cardiac rhythm up to complete standstill by gaseous

distension of the stomach in patients with heart disease. Similar conclusions were also reached by Sallet and associates [12]. This relationship was also observed and reported by one of us (A. R.) in association with Lortat-Jacob and Parma [13].

Thus, the consensus is that autonomic reflexes seem to be responsible for this painful symptomatology; however, there is also some evidence that mechanical compression by the herniated viscus may be involved. This is particularly true when the hernias are of the large "balloon type" described by Effler [14]. The air and fluid present in the stomach displace an equivalent amount of air in the lungs (Effler). It appears that this situation can seriously interfere with normal cardiac function by pushing the heart forward against the sternum to produce "cardiac tamponade from without the pericardial sac."

Our patient's hernia seems to fit the category of "balloon hernia" as described by Effler. The sequence of events was probably as follows: The initial incident was the incarceration of the right femoral hernia; the dilatation of the small bowel proximal to the obstruction tremendously increased the intra-abdominal pressure, probably enlarged the already loose esophageal hiatus and forced the greater part of the stomach into the chest. Although it is a matter of conjecture, mechanical compression of the heart by the stomach, as well as autonomic reflexes possibly originating in the hiatal hernia, may have compromised the already damaged coronary arteries of this patient and precipitated coronary thrombosis and myocardial infarction.

Only one other case is reported in the literature that resembles the present one. The patient had had definite attacks of angina pectoris when his stomach was distended. He refused surgery and eventually died from coronary occlusion possibly induced by gastric distention with cardiac displacement [15].

SUMMARY

An unusual case of hiatal hernia is reported. An unrecognized incarcerated femoral hernia of the Richter type precipitated a series of events that forced the greater part of the stomach into the chest, displacing the heart and culminating in death from myocardial infarction. The role played by a large herniated stomach in producing coronary thrombosis is discussed in the light of the radiologic and autopsy findings and in relation to a review of clinical and experimental observations.

REFERENCES

1. Von Bergmann, G. Erwiderung zu: Anatomisch-klinischer und röntgenologischer Beitrag zur "Hiatuschernie" von Sauerbruch, Chaoul, Adam. *Deutsche med. Wchnschr.*, 58: 1397, 1932.
2. Harrington, S. W. Diaphragmatic hernia: symptoms and surgical treatment in 60 cases. *J. A. M. A.*, 101: 987, 1933.
3. Harrington, S. W. and Kirklin, B. R. The clinical and radiological manifestations and surgical treatment of diaphragmatic hernia with a review of 131 cases. *Radiology*, 30: 147, 1938.
4. Salzberg, A. M. and Blades, B. The diagnosis of esophageal hiatus hernia. *Postgrad. Med.*, 7: 14, 1954.
5. Sweet, R. H. Analysis of 130 cases of hiatus hernia treated surgically. *J. A. M. A.*, 151: 376, 1952.
6. Jones, C. M. and Chapman, W. P. Studies on the mechanism of the pain of angina pectoris with particular relation to hiatus hernia. *Tr. A. Am. Physicians*, 57: 139, 1942.
7. Gilbert, N. C., Fenn, G. K., Leroy, G. V. and Hobbs, T. G. The role of sympathetic inhibition in the production of attacks of angina pectoris. *Tr. A. Am. Physicians*, 57: 95, 1942.
8. Holoubeck, J. E., Carroll, W. H., Langford, R. B. and Riley, G. M. Hernia through esophageal hiatus simulating coronary pain: 50 case reports. *Southb. M. J.*, 47: 1043, 1954.
9. Palmer, E. D. Serious heart disease simulated by hiatus hernia. *U. S. Armed Forces M. J.*, 3: 477, 1955.
10. Master, A. M., Dack, S., Stone, J. and Grishman, A. Differential diagnosis of hiatus hernia and coronary artery disease. *Arch. Surg.*, 58: 428, 1949.
11. Morrison, A. and Schwalm, L. T. Role of gastrointestinal tract in production of cardiac symptoms. *J. A. M. A.*, 114: 217, 1940.
12. Sallet, J., Doreau, J. L., Tetreau, H. and Maurat, J. P. Retrosternal pain and coronary disturbances caused by gastric hernia through the esophageal hiatus. *Bull. et mém. Soc. méd. d. hôp. Paris*, 70: 625, 1954.
13. Lortat-Jacob, J. L., Parma, A. and Riberi, A. A better knowledge of the pathology of the esophageal hiatus: cardio-tuberositary malpositions. *Arch. ital. mal. app. diger.*, 20: 247, 1954.
14. Effler, D. B. Esophageal hiatus hernia. *Postgrad. Med.*, 7: 14, 1954.
15. Wilkinson, A. and Adams, H. D. Diaphragmatic hernia. *S. Clin. Northb America*, 141: 657, 1942.

Traumatic Rupture of the Gallbladder without a Penetrating Wound of the Abdominal Wall

W. Clayton Davis, M.D. and John D. German, M.D., *Man, West Virginia*

From the Surgical Service, Man Memorial Hospital of the Miners Memorial Hospital Association, Man, West Virginia.

In the absence of a penetrating wound of the abdomen and the presence of a norma gallbladder, traumatic rupture of this organ is seen so infrequently that the condition is seldom suspected or diagnosed preoperatively. Since emergency surgical intervention is necessary as soon as the diagnosis is suspected, the following case is reported, the literature reviewed, and the diagnosis and treatment discussed.

CASE REPORT

The patient, a seven year old white boy, was admitted to the Man Memorial Hospital on March 31, 1957. Approximately four hours prior to admission he fell from the top of an outhouse, where he was playing, onto the supporting boards of the fence of a chicken coop. He landed across his epigastrium and immediately reported abdominal pain to his parents. He was given water and vomited twice, the vomitus consisting of mucus and water. He had urinated shortly prior to the injury and had neither defecated nor urinated afterward. He was seen by his local physician who referred him to the hospital for evaluation and treatment.

Other than a tendon repair of the flexors of the right wrist one year previously, the past medical history revealed no major injuries, illnesses or surgery. The family history was non-contributory.

On general examination the boy was cooperative but complained bitterly of abdominal pain. He had an extreme thirst and was perspiring profusely. Physical examination was entirely normal except for the abdominal findings. There was generalized abdominal rigidity with no definite localization of tenderness. Peristalsis was absent. Rectal examination showed exquisite tenderness to palpation of the anterior rectal wall. There was one small superficial abrasion in the right periumbilical region. This was the only gross abnormality on the skin of the body.

Laboratory examination showed a white blood count of 35,200 per cu. mm.; the hemoglobin was 14.1 gm. per cent and the hematocrit 47 per cent. The differential count showed 67 polymorphonuclear leukocytes, 24 stab forms of polymorphonuclear leukocytes, 6 lymphocytes and 3 monocytes. Urinalysis showed a trace of albumin and sugar but was negative for acetone. Microscopic examination of the urine showed occasional red cells and 10 to 12 white blood cells per high-power field.

Roentgenographic examination of the abdomen with the patient in the prone and upright positions revealed no evidence of intra-abdominal disorders. There was some scattered gas in the small bowel but no evidence of dilatation. No calculi or free air were seen. Roentgenographic examination of the chest showed no abnormalities.

The abdominal physical findings definitely supported the diagnosis of an acute surgical condition of the abdomen, post-traumatic. It was believed that exploratory laparotomy was mandatory. The most marked trauma on the early physical examination appeared to be in the area of the right upper quadrant of the abdomen. Laceration of the liver was suspected but was not supported because of the normal hemoglobin and hematocrit values. It was thought that rupture of a hollow viscus was probable because of the abdominal findings supporting chemical peritonitis.

A Levin tube was placed in the stomach and within one hour after admission to the hospital and five hours following the injury, the child was taken to the operating room after preoperative preparation for exploratory laparotomy.

Under adequate general anesthesia a right paramedian rectus incision was made. The rectus muscle was reflected laterally, and the peritoneal cavity was opened and found to contain approximately 600 cc. of brownish red fluid. After exploral

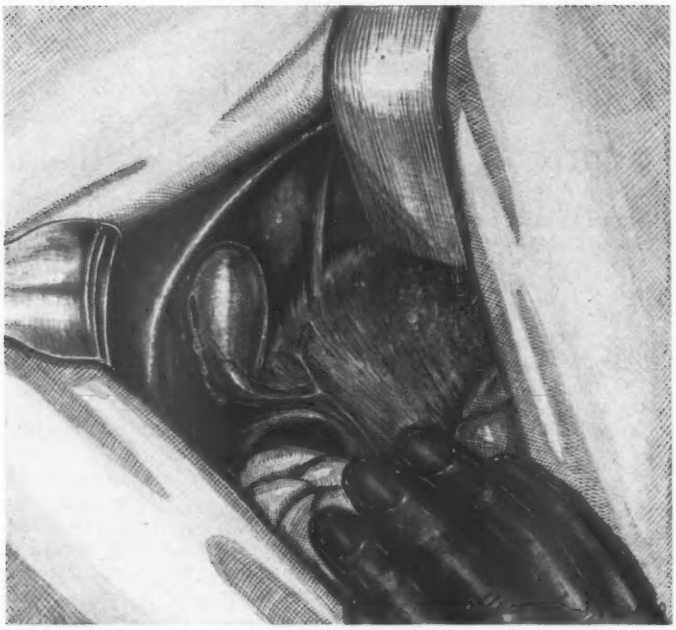


FIG. 1. Artist's conception of surgical findings. Note laceration of the gallbladder on the right lateral surface midway between the entrance of the cystic duct and the fundus.

tion of the entire peritoneal cavity the only abnormality found was a laceration of the gallbladder on the right lateral surface midway between the entrance of the cystic duct and the fundus. (Fig. 1.) The laceration was approximately 1 cm. in length and bile was exuding from it. A small clot of blood over the laceration was removed. The gallbladder and liver were otherwise entirely normal. The peritoneal cavity was aspirated and the laceration was closed using No. 4-0 Atraumatic® interrupted chromic catgut sutures approximating all layers. A row of No. 4-0 Atraumatic silk sutures approximated the serosa. Following this, exploration was repeated in the abdominal cavity and a very small retroperitoneal hematoma on the right, insignificant in size and located in a perinephric position, was noted. The small and large intestines were then examined, and other than the presence of Ascaris lumbricoides as an intraluminal parasite, examination was normal. A drain was placed through a stab wound in the right upper quadrant lateral to the right rectus incision, at the foramen of Winslow. The peritoneal cavity was then closed in the usual manner. The patient was returned to the recovery room in good condition, having tolerated the anesthesia and operation well.

The patient made a completely uneventful recovery and was discharged to outpatient follow-up on April 4, 1957. He continued to be completely asymptomatic and an oral cholecystogram on April 22, 1957, showed the gallbladder to be entirely normal in outline without evidence of calculus, filling defect or other abnormality. He was seen approximately one year following operation and was still asymptomatic, with a normal gallbladder.

COMMENTS

Etiology. The ease with which an abnormal gallbladder can be traumatically ruptured or dissected free from the liver bed is easily understood. The incidence of perforation of a normal gallbladder without a penetrating wound of the abdomen should be low. A review of the literature supports this. The discussion of Smith and Hastings [9] in 1954 summarized thirty-five cases, including their own, of traumatic rupture of the gallbladder. Many of these were abnormal before trauma but the exact number was not stated. One could expect a pendulous, loosely attached but otherwise normal gallbladder to be easily injured. The patient reported on herein showed no anatomic or pathologic condition at operation to explain

the ease of injury, and is the youngest patient described.

Diagnosis. All authors agree that it is almost impossible to determine the diagnosis preoperatively. It must be made as a chemical bile peritonitis. The complications of this are so great that the diagnosis must be considered in non-penetrating injury to the right upper abdominal quadrant. The exact nature of the harmful effect of bile in the peritoneal cavity is still questioned [*4,5*]. Some believe it is due to the irritating effect of bile acids and salts. It has been shown in this reported case that following the peritoneal introduction of bile, ascites rapidly develops causing massive fluid loss from the extracellular compartment. This may be the lethal effect of bile peritonitis although certainly bacterial growth will be a complication if operation is delayed too long. Most authors believe that shock is the chief cause of death from bile peritonitis. Whatever causes the death, bile peritonitis carries a mortality rate from an estimated minimum of 50 per cent on upwards in the reports of previous authors [*3,5*].

A review of the literature will impress one with the fact that the diagnosis is difficult. Symptoms of bile peritonitis develop more slowly than those of intraperitoneal hemorrhage. Nevertheless, in the presently reported case, symptoms were sudden and rapid in onset.

We do not believe that paracentesis abdominis is a logical preoperative procedure. One would do better to perform exploratory laparotomy than confuse diagnosis and treatment by a false-negative aspiration. This procedure is not without complications and delay in operation is most hazardous.

Treatment. Operation is mandatory if any suspicion of perforation of the gallbladder is present. Knepper et al. [*2*] stated in 1956 that traumatic rupture of the gallbladder should be treated by cholecystectomy. In the instance of this seven year old boy, we believed that there was no indication to remove the otherwise normal organ. It might be surmised that the suture line could serve as a nidus for future cholelithiasis. We believe that with proper technic in closure of small lacerations there should be no increased incidence of future abnormality of the gallbladder. Certainly major destruction of the gallbladder or an abnormal one would indicate cholecystectomy.

With the increase in acceleration-deceleration injuries, we may expect an increase in the incidence of these rarer injuries of closed abdominal trauma. One must perform exploratory laparotomy more often when the findings support such intervention rather than delay operation with observation.

SUMMARY

1. A case is presented of traumatic rupture of an otherwise normal gallbladder in a young boy.

2. The etiology, diagnosis and treatment are discussed.

Acknowledgment: We wish to express our thanks to Dr. Ivars V. Sprogis for the medical drawing.

REFERENCES

1. Fitts, W. T., Jr., DeMuth, W. E., Jr. and Ravdin, I. S. Hemoperitoneum from perforation of gallbladder. *Arch. Surg.*, 63: 702–705, 1951.
2. Knepper, P. A., Riddell, F. V. and McDaniel, J. R. Traumatic rupture of the gallbladder without a penetrating wound of the abdominal wall. *Arch. Surg.*, 73: 371–372, 1956.
3. Mason, C. B., Judd, C. S. and Hill, R. L. Rupture of the gallbladder with intraperitoneal hemorrhage. *New England J. Med.*, 256: 609–610, 1957.
4. Newell, C. E. Traumatic rupture of the gallbladder and liver. *Am. J. Surg.*, 76: 466–471, 1958.
5. Norgore, M. Traumatic rupture of the gallbladder. *Ann. Surg.*, 123: 127–134, 1946.
6. Parker, W. S. and Robbins, F. R. Traumatic amputation of gallbladder without a wound of the abdominal wall. *Ann. Surg.*, 138: 915–916, 1953.
7. Sengstacken, R. F. Traumatic rupture of the gallbladder. *Ann. Surg.*, 119: 959, 1944.
8. Shannon, J. M. Avulsion of the gallbladder from the liver bed. *New England J. Med.*, 253: 521, 1955.
9. Smith, S. W. and Hastings, T. N. Traumatic rupture of the gallbladder. *Ann. Surg.*, 139: 517–520, 1954.

Intussusception of the Vermiform Appendix

WILSON JUCA, M.D., *Fortaleza-Ceara, Brazil*

From the Surgical Service of Ipase, Ceara, Brazil.

IN listing the many causes of pain in the right lower quadrant of the abdomen, intussusception of the vermiform appendix is found far down on the pathological list.

This impression is substantiated when a review of the world literature is made and about 100 cases were published to 1957 [8].

It is readily admitted that many cases are not reported but if one explores the surgical and pathological records of any hospital, very few cases of intussusception of the vermiform appendix will be found.

In 50,000 specimens of the human vermiform appendix, Collins [1] could identify only two cases of inverted appendix (0.004 per cent). The purpose of this paper is to study a new case of this rare condition.

CASE REPORT

The patient, a seventeen year old white girl, was admitted (No. 20,825, Dr. Cesar Cals Hospital) with a chief complaint of pain in the right lower quadrant of the abdomen. From the clinic, a history of nausea, vomiting and diarrhea during the previous two days was elicited. The pain had been cramp-like, on and off for about nine days. The patient was slender, well developed and well nourished. On examination, the abdomen was soft and there was some tenderness in the right lower quadrant. A mass was felt on digital rectal examination.

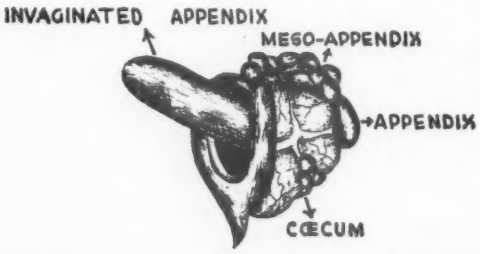


FIG. 1

Laboratory data were as follows: the results of blood count and urinalysis were within normal limits. The stool was negative for worms and occult blood. With the probable diagnosis of appendicitis, the young patient was taken to surgery for exploratory laparotomy.

At operation with the patient under endotracheal anesthesia, a transverse incision (Rockey incision) was made over the right lower quadrant and the abdominal cavity was opened. The cecum was identified and the vermiform appendix was sought in its anatomical position.

A stump-like object was found at the end of the cecum which on delivery proved to be an intussusception of the appendix. On palpation, a tumor mass was felt extending into the cecum in contact with the stump-appendix. Reduction of the intussusception was attempted but was not possible. Opening the cecum for the reduction of the intussusception was not advisable because the patient has not been prepared for open intestinal surgery. The cecum was shut off by means of an intestinal clamp and the appendix excised together with about 3 cm. of surrounding cecal wall. This was closed by a continous through and through suture of catgut (No. 3-0) and then buried by interrupted Lembert sutures of cotton (No. 3-0). The peritoneal cavity was closed without drainage and the abdominal layers were drawn together with cotton stitches. The patient was dismissed from the hospital on her seventh postoperative day.

The specimen consisted of the vermiform appendix and a portion of the wall of the cecum. (Fig. 1.) The appendix was 7 cm. in length, its distal end was invaginated through the proximal end into the cecal segment. The invaginated appendix was swollen and congested and it could not be reduced. The mesoappendix was thick and firm with some necrosis close to the intussuscepted segment. The cecal wall surrounding the intussusceptum of the appendix was normal.

COMMENTS

In 1858 McKidd [9] published the first case of intussusception of the appendix. Since then this rare condition has increased the differential

diagnosis of pain in the right lower quadrant of the abdomen.

In 1904 Jalaguier [6] published the first correct diagnosis of an intussusception of the appendix in his third recorded case. This appears to be the only recorded instance of an intussusception of the appendix being diagnosed clinically, since the knowledge of this new disorder.

Coopernail [2] as far back as 1933 described an intussusception of the vermiform appendix in a two and a half year old white girl and stated "a case similar . . . has never been published in medical literature." In 1941, Skarby [12] was able to make the first x-ray diagnosis of intussusception of the appendix by an opaque enema which showed a filling defect in the cecum.

A review of the world literature discloses that preoperative diagnosis of this rare disorder is very difficult because it is generally confused clinically with inflammation of the appendix, or radiologically with a tumor of the cecum.

In eighty-one recorded cases McSwain [10] stated the average age of patients with this entity to be sixteen years and the majority of cases to occur in the first decade of life. The incidence of occurrence in males to females is four or five to one.

ETIOLOGY AND PATHOLOGY

In 1904, Gunn and Whitelock [5] reported a series of experiments in which they showed the appendix to be capable of rhythmic peristaltic contractions. These experiments were confirmed by Dannis [3] in a study of 289 appendices.

Rich in Meissner's and Auerbach's plexi, the appendix is capable of peristaltic contractions when a foreign body is causing irritation in its lumen. This etiology of intussusception of the appendix was taught by Rolleston [11] in 1898 when he published his case in which "the appendix tried to extrude a foreign body from within its lumen." In 1931, MacDermott [7] in an anatomical study, described a muscular sphincter at the base of the appendix. In these anatomical and physiological studies we can find an explanation for the intussusception of the vermiform appendix.

In our case the intussuscepted appendix, starting the invagination into its nearest portion and caught by the spasm of the muscular sphincter of the base, could not be reduced. The venous return was jeopardized and the intussuscepted appendix became swollen and edematous, bringing difficulty in the surgical reduction of the intussusception.

Whitrow [13] and Frazer [4] have published the only two cases to date of this type (McSwain —type 1) of intussusception of the vermiform appendix. Our patient is the third case of this type recorded.

SUMMARY

A case of intussusception of the appendix is presented.

REFERENCES

1. Collins, D. C. A study of 50,000 specimens of the human vermiform appendix. *Surg., Gynec. & Obst.*, 101: 437–45, 1955.
2. Coopernail, G. P. Intussusception of the appendix. *Am. J. Surg.*, 20: 95–6, 1933.
3. Dannis, H. *Arch. Surg.*, 43: 1021, 1941. Cited by Frazer, K. [4].
4. Frazer, K. Intussusception of the appendix. *Brit. J. Surg.*, 31: 23–33, 1943.
5. Gunn, J. and Whitelock, *Brit. J. Surg.*, 2: 92, 1904. Cited by Frazer, K. [4].
6. Jalaguier, E. Traite des Maladies d'Enfance, 2nd. ed. Paris, 1904. Monad Ch. Edetcurs.
7. MacDermott, E. N. Appendeceo-cecal intussusception. *Brit. M. J.*, 1: 5, 1931.
8. McCormick, W. F. Intussusception of the vermiform appendix with a mucocele. *Arch. Path.*, 65: 686–90, 1957.
9. McKidd, J. Case of invagination of cecum and appendix. *Edinburgh. M. J.*, 4: 793–796, 1858.
10. McSwain, B. Intussusception of the appendix. Review of the literature and a report of a case. *South. M. J.*, 41: 263–71, 1941.
11. Rolleston, H. D. *Edinburgh. M. J.*, 4: 21, 1898. Cited by Frazer, K. [4].
12. Skarby, H. G. *Acta radiol.*, 22: 471, 1941. Cited by Forshall, I. Intussusception of the vermiform appendix with a report of seven cases in children. *Brit. J. Surg.*, 40: 305–312, 1953.
13. Whitrow, F. *Brit. M. J.*, 2: 181, 1930. Cited by Frazer, K. [4].

SPECIAL DEPARTMENTS

Surgery Court Cases

HOWARD NEWCOMB MORSE,* *Atlanta, Georgia*

NARDINI VS. GILBERT

United States Court of Appeals for the Fourth Circuit

260 F. 2d 177

This was a malpractice case brought by a patient against a surgeon. The District Court of the United States for the Eastern District of Virginia directed a verdict in favor of the surgeon, and the patient appealed.

The patient was suffering from a painful and swollen knee, and after consulting the surgeon and undergoing certain treatments which proved ineffective, she entered the hospital for surgery. The surgeon made a tentative diagnosis of the ailment as a torn medial meniscus. He was desirous of performing an exploratory operation to examine the inner knee and both medial and lateral menisci.

The operation was performed by entry from the lateral, instead of the medial, side of the knee. The anterior portion of the medial meniscus was removed in the course of the operation, and upon examination it was found there was a tear in the removed portion. For a time after the operation the patient suffered from what appeared to be an infection, and still later some restricted motion developed in the knee. Surgeons called by the patient testified that the customary approach in operating for a torn medial meniscus would be from the medial side and that they would not have operated from the lateral side.

The United States Court of Appeals for the Fourth Circuit affirmed the decision of the court below. The United States Court of Appeals declared: "While it is clear that his (the surgeon's) approach to the medial meniscus, if it were known with definiteness that the fault lay there, was not the usual approach, the surgeon was, nevertheless, able to remove the torn portion of the medial meniscus, and none of the experts was prepared to say that his procedure was improper."

FLYNN VS. STEARNS

Appellate Division of Superior Court of New Jersey

52 N. J. Super. 115, 145 A. 2d 33

The patient, an eight year old girl, broke her arm. She was taken immediately to a hospital and placed under the care of the defendant-surgeon. The surgeon diagnosed her injury as a "super condylar fracture, right humerus." The surgeon twice attempted a closed reduction of the fracture but the result was not satisfactory. Therefore, the surgeon did an "open reduction," that is, surgery performed with the patient under anesthesia, during which the flesh was cut to expose the bone and the ends of the fracture were joined.

The wound became infected and the patient's temperature rose. Consequently, on the day after the operation the surgeon split the cast and exposed the wound to allow it to drain. That, and antibiotics and other treatment, gradually lowered her temperature but not sufficiently. Therefore, the surgeon "opened

* Counsellor at Law of the Supreme Court of the United States of America.

the wound entirely and put some vaseline gauze in it to keep it open and then the drainage could completely drain out and the wound could heal."

The wound thereafter healed completely, and the patient was discharged from the hospital. The union of the fracture was good, and the patient made no complaint about the bone condition which resulted. However, the patient, by her father, contended that the infection which set in after the operation affected the tissue in the elbow in a manner which caused her to lose the ability to bend it.

When the patient was discharged from the hospital she could move her elbow "over a range of only 20 degrees," according to the surgeon's note in the hospital record. Consequently, he directed her to come to his office for physiotherapy. He "worked over her to get motion for a period of two months." He noted, "Patient holds a one pound weight in hand with elbow on table. This stretches scar tissue at elbow and allows extension. Hand can be raised to mouth. Movement over 50 degrees range. There is definite progress but still limited flexion. Extension to 135 degrees."

The surgeon told the patient's parents he could do nothing further for her, except possibly perform another operation when she was older, and he terminated the treatments at his office. He instructed the patient and her parents that the stretching exercises be continued at home. Those exercises consisted principally of carrying and lifting an iron or other weight for some period each day. The patient never went back to the surgeon for further examination or treatment.

The patient did not continue the exercises. With the exercises, the surgeon "expected . . . that she would have a much better range of motion," but he never expected the elbow to go back to normal. The stiffness in the elbow increased and eventually the patient lost even the motion she had when she last saw the surgeon. Her range of motion "diminished to minimal."

The patient, by her father, filed an action against the surgeon for damages for alleged malpractice. She based her action upon the following two grounds: (1) the surgeon did not take proper precautions against infection in performing the operation for open reduction, and (2) the open reduction was unnecessary, for had the surgeon taken a portable x-ray film while attempting the "closed reduction," that is, by manipulation, he would have been able to "set" the fracture without any operation.

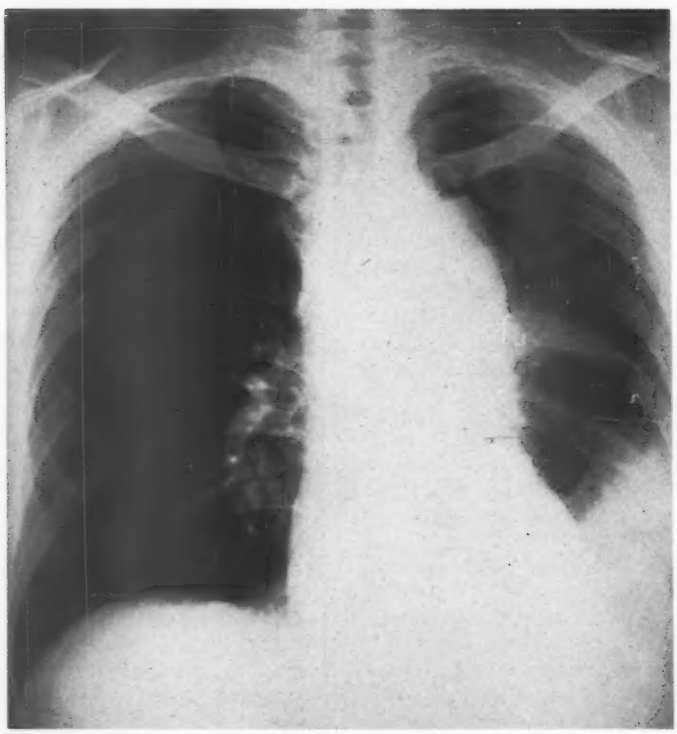
The surgeon defended on the ground that the patient was guilty of contributory negligence in that she failed to follow the directions which the surgeon ordered at the time he discharged her. A jury in the Superior Court of New Jersey returned a verdict for the surgeon, and the court entered judgment accordingly. The patient, by her father, appealed. The Appellate Division of the Superior Court of New Jersey reversed the decision of the court below. The Appellate Division held that since the fault, if any, of the patient was subsequent to the fault of the surgeon it was not a proximate contributing cause of the injury, and it should have been submitted to the jury, if at all, only as bearing on the issue of damages, and not as a basis for a finding of contributory negligence.

The Diagnostic Corner

An important and recognizable type of injury which often occurs to the driver of an automobile during sudden deceleration.

SIDNEY W. NELSON, M.D., *Columbus, Ohio*

From the Department of Radiology, The Ohio State University, Columbus, Ohio.



The Diagnostic Corner

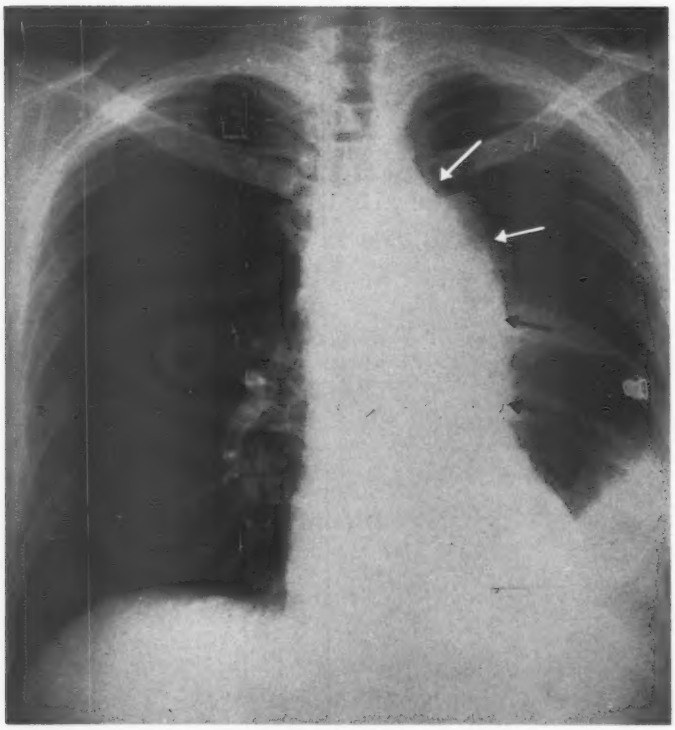
THIS thirty-four year old white physician was in a head-on automobile collision nine days prior to admission. He was wearing a seat belt and therefore was not thrown out of the car, although he received a contusion across the upper third of his thorax as it struck the steering wheel. He did not receive any noticeable abdominal injury, but did sustain a fracture of his mandible, a fracture of one of the ribs on the left side and a bilateral malleolar fracture of the left ankle. He was hospitalized at another institution where his blood pressure was noted to elevate; nine days after the accident it had reached 260/120 mm. Hg. At this time he complained of a severe back pain, warming of his genitals, and paresthesia and weakness of the lower extremities. His physician noted that he was unable to palpate any femoral or posterior tibial pulses at this time, and the patient was sent to the Ohio State University Hospital for study and treatment.

Physical examination at the time of admission showed an acutely ill white man complaining of severe back ache. Blood pressure was 230/120 mm. Hg in the right arm and 238/128 mm. Hg in the left arm. Pulse rate was 140 per minute. The teeth of the upper and lower jaws were wired together in order to immobilize the mandibular fracture. There was some dullness to percussion in the left base of the lung, the lungs otherwise being clear. The heart rate was regular. Examination of the abdomen was negative for abnormalities. The left leg was in a below-knee cast. Below the cast the foot was noted to be cold to palpation. Arterial pulsations were absent bilaterally. An x-ray film of the chest (opposite) showed fluid in the left base.

What is your diagnosis?

Please turn page for answer

Diagnosis: Dissecting traumatic aneurysm, descending thoracic aorta.



The history of steering-wheel trauma to the anterior chest occurring during sudden deceleration, as occurs to the driver in many automobile accidents, should focus attention on the possibility of a ruptured aorta. During deceleration the aortic arch can move. However, the proximal descending aorta is a relatively fixed structure, and during sudden deceleration its posterior attachment is frequently torn at a point 3 or 4 cm. distal to the origin of the left subclavian artery. A large tear can result in a massive mediastinal hemorrhage, with death occurring very soon after injury, whereas a smaller rent can result in less rapid bleeding and a less fulminating course, as occurred in the patient presented herein.

Of great interest is the fact that the attending physician noted the blood pressure was rising and had reached the level of 260/120 mm. Hg on the ninth day after the injury. This undoubtedly was due to the fact that the periaortic hematoma and the dissecting aneurysm had resulted in a high grade narrowing of the lumen of the descending aorta. Therefore, from a hemodynamic standpoint the situation resembled coarctation of the aorta. This occlusion also accounted for the absence of femoral and other arterial pulsations in the lower extremities. The dysesthesia and paresthesia in both of the lower extremities, perineum and penis were probably due to the fact that the dissecting aneurysm had seriously interfered with the arterial blood flow through the spinal branches of the intercostal arteries. The compromise of blood flow through these arteries and resultant ischemia of the spinal cord must have accounted for the sensory and motor changes in the lower extremities.

The x-ray changes are highly suggestive of the diagnosis of a ruptured aorta in a young patient with this history of trauma. One would expect to see a very sharply defined aortic arch on the x-ray film of the chest of a young person, whereas this patient had an extremely poorly defined aortic arch (arrows on film opposite), which was also much larger than normal. In the older age groups an atherosclerotic dissecting aortic aneurysm or possibly a neoplasm very closely related to the descending aorta might conceivably produce this same appearance.

The patient was operated upon under hypothermia, and a large dissecting aneurysm of the upper thoracic aorta was encountered. The entire wall of the aneurysm was very friable. The dissecting aneurysm and the periaortic clot had resulted in almost complete obliteration of the aortic lumen. The patient's condition was quite precarious and it was elected to perform the most conservative procedure, which at the time was believed to be the insertion of a nylon graft to attempt to bridge the 5 cm. gap between viable aortic tissue on the proximal and distal sides of the lesion. The edema and friability of the aorta on both sides of the non-viable tissue prevented the sutures from holding. Bleeding was extremely profuse during the attempted procedure, and in spite of massive blood replacement the patient died before a more extensive resection of the thoracic aorta could be performed.

REFERENCES

1. Goyette, E. M., Blake, H. A., Forsee, J. H. and Swan, H. Traumatic aortic aneurysms. *Circulation*, 10: 824–828, 1954.
2. Hollingsworth, R. K., Johnston, W. W. and McCooey, J. F. Traumatic saccular aneurysm of the thoracic aorta. *J. Thoracic Surg.*, 24: 325–343, 1952.
3. Kastl, W. H. Traumatic rupture of the thoracic aorta: a case report. *Ann. Surg.*, 132: 111–114, 1953.
4. Wyman, A. C. Roentgenologic diagnosis of traumatic rupture of thoracic aorta. *Arch. Surg.*, 66: 656–663, 1953.

The Diagnostic Corner

An interesting diagnostic problem of a newborn infant who was unable to retain oral fluids.

SIDNEY W. NELSON, M.D., *Columbus, Ohio*

From the Department of Radiology, The Ohio State University, Columbus, Ohio.

The Diagnostic Corner

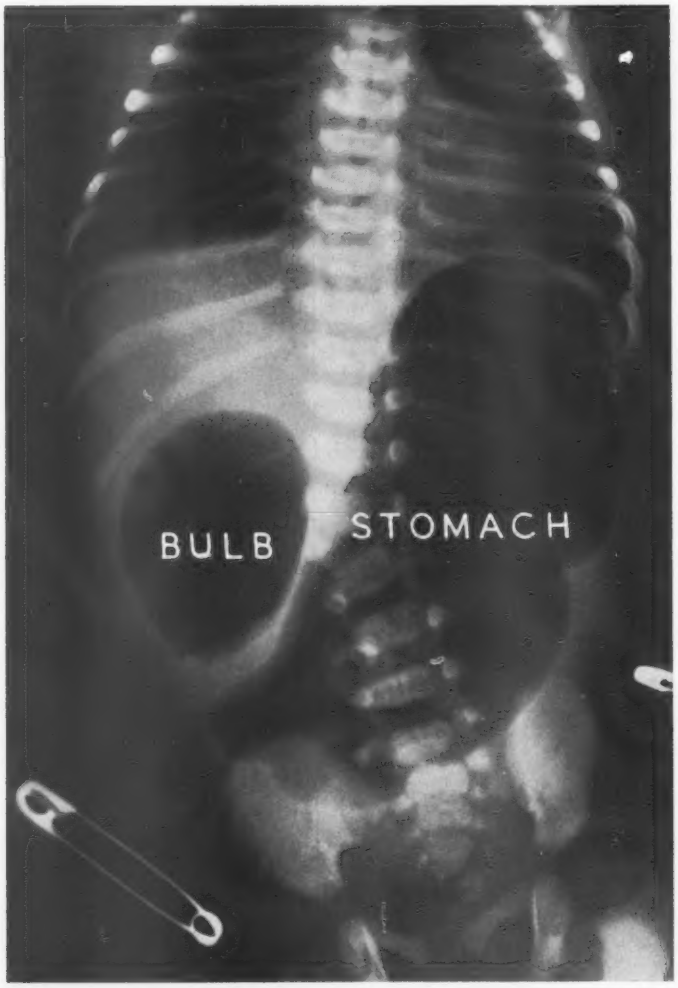
THIS five day old male infant was admitted to Columbus Children's Hospital on February 18, 1958, because of jaundice which had been noted at birth in another institution. At birth the patient weighed 5 pounds, 14 ounces, and the weight had dropped to 4 pounds, 12 ounces on the day of admission to Children's Hospital. The patient's mother had a history of polyhydramnios during her pregnancy, and delivery had been by cesarean section. Physical examination showed a very dehydrated infant in no apparent acute distress. The patient was unable to retain fluids orally. Hemoglobin was 17.7 gm. per cent. White blood count was 12,950 per cu. mm., with a normal differential count. The indirect van den Bergh was 11.4 mg. per cent, the total van den Bergh 11.6 mg. per cent. Electrolytes were within normal limits, except for serum chlorides which were 78 mEq./L. Blood urea nitrogen was 37.5 mg. per cent. Sodium was 126 mEq., potassium 5.1 mEq. Stool examinations on the day of admission were positive for trypsin. Gastric aspiration was negative for trypsin.

X-ray films of the abdomen with the patient in supine and upright positions showed an interesting finding consisting of a large amount of air in the stomach, which occupied almost the entire left side of the abdomen, and a second collection of air and fluid to the right of the gastric outline (see film opposite). These findings are characteristic of a specific type of problem producing the previously described clinical state in newborn infants.

What is your diagnosis?

Please turn page for answer

Diagnosis: Duodenal stenosis proximal to the ampulla of Vater.



The x-ray findings in this patient show the classic "double bubble" indicating a high grade duodenal obstruction in the second portion of the duodenum (see film opposite). When the "double bubble" sign is seen, the large bubble occupying the left side of the patient's abdomen is due to the marked amount of air in the obstructed stomach. The second bubble, lying farthest to the patient's right, is almost always due to a large distended duodenal bulb just proximal to the obstruction in part II of the duodenum. If there is too much fluid in the stomach, a catheter can be introduced, through which the fluid can be aspirated and air injected into the stomach. Then, by taking x-ray films of the patient in upright and inverted positions, the diagnosis can almost always be accurately made on the basis of the characteristic configuration of the "double bubble."

This "double bubble" appearance has been described as almost always being due to duodenal atresia or an annular pancreas. It is doubtful that these two conditions can be differentiated on the basis of x-ray films alone. It is extremely important that barium not be administered orally or given by rectum to these infants, inasmuch as the plain x-ray findings themselves are classic for this condition and can localize the site of the obstruction. When large amounts of barium are given orally or rectally, the diagnosis becomes more difficult; furthermore, a lot of unnecessary material is placed in the gastrointestinal tract of these infants.

Another point of diagnostic interest is the history of polyhydramnios in the infant's mother. This is often a result of obstructing gastrointestinal lesions which interfere with absorption of amniotic fluid from the gastrointestinal tract of the fetus.

The duodenal stenosis in this patient was not complete as in cases of duodenal atresia. Although the roentgenograms did not show any gas distal to the proximal duodenum, at surgery there were a few bubbles of gas in the proximal jejunum which was about the size of a lead pencil because of the high grade duodenal stenosis. Duodenal jejunostomy was performed; the colon was normally rotated. There were a few adhesions in the region of the duodenum which were not divided. The patient had an uneventful postoperative course.

Acknowledgment: I am grateful to Dr. William Howard, radiologist at Columbus Children's Hospital, and Dr. William Clatworthy, the chief surgeon of the Columbus Children's Hospital, for allowing me to use this case.

REFERENCES

1. Singleton, E. B. X-ray Diagnosis of the Alimentary Tract in Infants and Children, pp. 172–178, 184–189. Chicago, 1959. Year Book Publishers.
2. Hope, J. W. and O'Hara, A. E. Use of contrast medium in the diagnosis of intestinal obstruction of the newborn. *Radiology*, 70: 349, 1958.
3. Craig, R. M., Hodgson, J. R. and Dockerty, M. B. Obstruction of the small intestine in infants and children. *Am. J. Roentgenol.*, 72: 412, 1954.
4. Eek, S. Congenital duodenal obstruction. *Am. J. Roentgenol.*, 73: 713–714, 1955.
5. Moore, T. C. Congenital intrinsic duodenal obstruction: report of thirty-two cases. *Ann. Surg.*, 144: 159, 1956.
6. Mellins, H. Z. and Milman, D. H. Congenital duodenal obstruction: roentgen diagnosis by insufflation of air. *Am. J. Dis. Child.*, 72: 81, 1946.

Case Analysis Clinic

POSTINFECTIOUS THROMBOCYTOPENIC PURPURA AND ITS MANAGEMENT

THOMAS L. MEYER, JR., M.D., *Columbus, Ohio*

From the Department of Surgery, Obio State University Medical Center, Columbus, Obio.

PATIENT D. H., a four year old white boy, was admitted to the Hematology Service of University Hospital because of epistaxis, petechiae and ecchymosis. He had been exposed to varicella, and broke out with the typical lesions twenty days later. The course of the exanthem was not unusual until the third day when his mother noted multiple bruises over his body. Nosebleeds also developed which were difficult to stop. These symptoms persisted for two days prior to admission.

The patient had two brothers who were afflicted with a "bleeding tendency," one having required blood transfusions.

PHYSICAL AND LABORATORY FINDINGS

The child was well developed and well nourished. He was crying but in no distress. His temperature was 100°F. rectally; pulse was 96 and respirations 32 per minute. Blood was oozing from the nose, and the skin was covered with varicella lesions in all stages of development. In addition, there were many petechiae and ecchymotic areas over the body. The liver was palpated 4 cm. below the right costal margin, and several examiners palpated the tip of the spleen.

On admission, the hemoglobin was 11.3 gm. per cent; red blood count, 3.9 million per cu. mm.; and white blood count, 9,500 per cu. mm. (57 per cent lymphocytes). The reticulocyte count was 0.8 per cent and platelet count 3,940 per cu. mm. Urinalysis showed only 3 to 5 red blood cells per high power field, and the stool was guaiac-negative. Blood urea nitrogen, prothrombin time and coagulation time (using the Lee-White method) were all within normal limits. There was no retraction of the clot after twenty-four hours. Aspiration of the bone marrow showed abundant and hyperplastic megakaryocytes, and was interpreted as being compatible with postinfectious thrombocytopenic purpura.

EARLY MANAGEMENT AND LATER COURSE

The diagnosis of postinfectious thrombocytopenic purpura was made, and the administration of prednisone, 20 mg. every six hours, was begun. The patient was also followed up closely for signs of intracranial hemorrhage. The platelet count rose steadily to 63,420 per cu. mm. during the first three days of therapy, then dropped to 17,000 per cu. mm. before rising to 117,000 per cu. mm. on the eleventh hospital day. During this time, the varicella cleared and no new petechiae developed. Hemoglobin and red blood cell count remained stable.

Because of the development of moon facies, hypertension and a 4 pound weight gain, the dose of prednisone was reduced by 10 mg. every other day. Four days later the platelet count dropped to 30,000 per cu. mm. and, although no new hemorrhagic lesions developed, the patient was transferred to the Surgical Service for splenectomy.

SURGERY

The patient received 75 mg. of hydrocortisone intramuscularly on the morning of surgery. With fresh blood available, a left paramedian incision was made from the xiphocostal angle to the umbilicus. The lesser sac was opened and the splenic artery was identified, clamped and ligated some distance from the spleen. The spleen was then freed and removed after its vessels were ligated separately with No. 2–0 sutures. The spleen weighed 60 gm. An accessory spleen 2 cm. in diameter was removed from

the splenocolic ligament, and a wedge of liver and a retroperitoneal lymph node were taken for biopsy. The wound was closed in layers. Blood loss was estimated at 200 cc. and it was replaced with 400 cc. of fresh blood. On the first postoperative day the platelet count rose to 836,000 per cu. mm. and then to 2,800,000 per cu. mm. by the third day. The dosage of hydrocortisone was gradually reduced over the next five days and then discontinued. Except for a temperature elevation of 102°F. rectally on the first postoperative day, the patient had an uneventful recovery. Six months later he was still in remission.

COMMENTS

Thrombocytopenic purpura, when primary, is called idiopathic thrombocytopenic purpura. When associated with conditions such as leukemia or anemia or when caused by certain chemical, physical or animal substances, it is known as secondary or symptomatic thrombocytopenic purpura.

Idiopathic thrombocytopenic purpura occurs most often in children and young adults. Not infrequently, there is a family history of ready bruising or other forms of bleeding. There is a tendency toward spontaneous remissions, and with corticosteroid therapy this tendency is greater. However, when remission fails to occur and bleeding continues, splenectomy has been curative in over 80 per cent of patients.

Treatment of the secondary forms of thrombocytopenic purpura depends on the associated condition. If the thrombocytopenia is due to replacement of bone marrow or toxic agents, splenectomy is not indicated. However, in certain instances, when the bone marrow discloses an adequate number of megakaryocytes, the treatment is the same as for the idiopathic form.

Such was the situation with the patient reported on herein. The diagnosis was based on the purpura, low platelet count and the bone marrow picture. Varicella was thought to be the etiologic agent, and because the exanthem is self-limiting, an attempt was made to delay splenectomy and hope for a spontaneous remission. The child was given prednisone because the corticosteroids have been found to reduce capillary fragility and increase the platelet count in a good number of patients.

It is essential to watch for signs of intracranial hemorrhage, for this is an indication for immediate splenectomy.

The patient responded well at first to corticosteroid therapy; the platelet count rose and bleeding stopped. However, when toxicity to prednisone necessitated a reduction in dosage, the platelet count fell precipitously and it was decided to perform splenectomy before hemorrhage recurred.

Fresh blood was made available as a ready source of platelets, should bleeding have become a problem during surgery. The splenic artery was identified and ligated before the spleen was mobilized. This was done because the platelet level is known to rise immediately after this; also there is probably less blood loss in subsequent steps. A search for accessory spleens is important because their presence might later cause an exacerbation. In the case presented, one was found and removed. Biopsy specimens of the liver and retroperitoneal lymph nodes are taken for diagnosis should other causes of hypersplenism be missed. In the case presented, they were negative for abnormalities.

Immediately after surgery the platelet count was found to rise sharply to extremely high levels, and no further bleeding occurred.

REFERENCES

1. Doan, C. A. Hypersplenism. *Bull. New York Acad. Med.*, 25: 625, 1949.
2. Doan, C. A. and Wright, C. S. Primary congenital and secondary acquired splenic panhematopenia. *Blood*, 1: 10, 1946.
3. Orebaugh, J. E. and Collier, F. A. Indications for splenectomy. *Surgery*, 37: 858, 1955.
4. Wintrobe, M. M. Clinical Hematology. Philadelphia, 1956. Lea & Febiger.
5. Zollinger, R. M. The surgical management of hypersplenism. *Missouri Med.*, 50: 193, 1953.

Case Analysis Clinic

HIATUS HERNIA AND ACID PEPTIC DISEASE

WILLIAM R. C. STEWART, M.D., *Columbus, Ohio*

From the Department of Surgery, The Ohio State University Medical Center, Columbus, Ohio.

PATIENT A. H. (No. 650589), a sixty-nine year old white woman, was admitted through the emergency room on December 16, 1958, with a three-week history of intermittent nausea and vomiting and a five-day history of tarry stools. The vomitus, initially, was clear and contained no bile, but over the previous week had become dark brown and resembled "coffee grounds." On the day of admission, following several episodes of severe retching, the patient vomited approximately one cupful of dark red blood.

During the previous fifteen years the patient had experienced intermittent epigastric burning pain, frequently occurring at night, which was relieved by food and antacids. For the past five years she had also experienced a severe substernal burning pain which was accentuated after eating and upon lying down.

Twice in the past five years the patient had had severe episodes of nausea and vomiting. Each lasted for several days but neither was accompanied by hematemesis. There was no history of jaundice, gallbladder trouble, dietary indiscretions or high intake of ethanol.

Past History. The patient's general health had been good except for hypertension and symptoms of mild congestive failure, for which she had been taking digitalis. She had always been rather obese but had lost approximately 25 pounds over the past year with dieting.

Physical Examination. On admission, the patient was a well developed, moderately obese white woman in no acute distress. Blood pressure was 140/100 Hg; pulse, 112 per minute; temperature and respirations were normal. The skin showed evidence of moderate dehydration. The heart was of normal size and rhythm. The thorax had an increased anteroposterior diameter with flaring of the lower rib cage. A few moist rales were heard in the bases of the lung bilaterally. The abdomen was soft and moderately distended in the left upper quadrant. Bowel sounds were normal. There was moderate epigastric tenderness but no masses or organs were palpated. The remainder of the physical examination was essentially normal.

Initial Laboratory Data. Admission hemoglobin was 13 gm. per cent. The hematocrit was 40 per cent. There were 20,000 white blood cells per cu. mm. with 88 per cent total neutrophils and 4 per cent band forms.

The urine had an acid reaction and a specific gravity of 1.032. There was no sugar or acetone, and the microscopic examination was negative for abnormalities. Serum amylase was 125 units; blood urea nitrogen, 21 mg./100 ml.; sodium, 142 mEq./L., potassium 4.1 mEq./L., chloride 97 mEq./L., and the carbon dioxide–combining power was 56 per cent. All of the liver function tests, prothrombin time, and bleeding and coagulation studies were within normal limits. An electrocardiogram revealed no abnormalities.

X-ray films of the chest showed moderate pulmonary emphysema. The heart was of normal size and contour but a retrocardiac density with an air-fluid level was noted.

HOSPITAL COURSE

In the emergency room, blood was obtained for initial laboratory studies and for type and cross match. An intravenous infusion of normal saline solution was immediately begun through the 18 gauge needle used for drawing the blood. A Foley catheter was placed in the bladder, and a Levin tube was inserted after history and physical examination suggested the patient was not bleeding from varices.

Approximately 1,300 cc. of coffee-ground,

guaiac-positive solution was aspirated from the stomach. A sample tested with Töpfer's reagent showed the presence of free hydrochloric acid.

The patient was transported to the floor only after stabilization of her vital signs was assured, an intravenous infusion was in place and whole blood was available.

Following hydration, the hemoglobin fell to 10 gm. per cent and the white blood count to 13,000 per cu. mm. It soon became obvious that the bleeding was not progressive.

A twelve-hour gastric analysis showed 710 cc. of gastric juice (normal, 400 cc.) with 36 mEq. of free hydrochloric acid (normal, 18 mEq.).

On the third hospital day an upper gastrointestinal series was performed. It demonstrated (1) a large sliding type hiatus hernia with ulceration; (2) marked deformity and stenosis of the duodenal bulb with a small active ulcer; and (3) a large dilated stomach secondary to partial obstruction.

The patient was maintained on constant nasogastric suction for five days. During this time her blood volume deficit was replaced, and fluid and electrolyte requirements were maintained by intravenous infusions. On the sixth hospital day the Levin tube was removed. Subsequent gastric residual studies showed no evidence of retention.

Strict ulcer management over the ensuing ten days was accompanied by a cessation of the patient's epigastric pain, but the severe substernal distress persisted.

On the sixteenth hospital day the patient was taken to the operating room. A midline incision, removing the xiphoid process, greatly facilitated exposure of the hiatus. The hernia was of the sliding type and measured approximately 6 cm. in diameter. Bilateral vagotomy was performed. The hernia was repaired by simple excision of the sac and closure of the diaphragmatic crus posterior to the stomach with interrupted No. 1–0 silk sutures, allowing enough room to pass the gloved finger through the hiatus. The cardioesophageal junction was then anchored to the undersurface of the diaphragm.

The duodenum showed marked scarring with the typical clover-leaf deformity, and pyloric obstruction. Pyloroplasty was performed in the routine manner. The stomach was anchored to the anterior abdominal wall by constructing a gastrostomy for postoperative decompression.

The patient's postoperative course was uneventful and she was discharged, asymptomatic, on her twelfth postoperative day.

COMMENTS

Symptoms. The clear history of epigastric pain, awakening the patient at night and subsiding following the ingestion of food or antacids, is certainly typical of duodenal ulcer. The more recent substernal burning pain effected by changes of position and intake of food suggests a reflux esophagitis.

Normally the competence of the cardioesophageal junction is maintained by the oblique insertion of the esophagus into the stomach, the intrinsic "sling" fibers of the stomach, the musculature of the right crux and the physiologic cardiac sphincter.

A hiatus hernia displaces the esophagus upward and affects the efficiency of these valvular mechanisms, allowing a reflux of the acid-peptic contents of the stomach.

Prolonged vomiting and, more rarely, heterotropic gastric mucosa in the lower esophagus ("Barrett's" ulcer) may also lead to esophagitis and ulceration.

In the case presented herein, a diagnosis of hiatus hernia could have been made before barium studies were performed, as the x-ray film of the chest showed a typical retrocardiac shadow containing an air-fluid level. Substernal distress, of the type presented herein, is the most common symptom of hiatus hernia. Dysphagia, the second most common symptom, indicating scarring or stricture, was not present initially. Upper gastrointestinal bleeding occurs in approximately one-fifth of symptomatic patients and is seldom massive.

Bleeding following prolonged vomiting suggests that hemorrhage is secondary to esophagitis. The relatively minor loss of blood in the patient presented herein would certainly conform to this diagnosis.

Two problems are therefore presented: hiatus hernia and acid-peptic disease involving both the duodenum and the esophagus. The large hiatus hernia allowed free reflux of acid-peptic secretions into the esophagus by creating cardiac incompetency. Associated with the duodenal ulcer was an increased concentration of free hydrochloric acid and an increased volume of gastric secretion available to reflux into the esophagus. The pyloric stenosis not only com-

pounded the esophageal erosion by causing repeated vomiting, but also acted as an added stimulus to secretion of hydrochloric acid by producing antral stasis and stimulation.

Management. Because of evidence of upper gastrointestinal bleeding, the initial management of the patient sought to evaluate the cause and severity of massive gastrointestinal hemorrhage and prevent exsanguination. All patients suspected of having massive gastrointestinal hemorrhage are managed in the manner described herein.

A large needle (16 or 18 gauge) is inserted into a vein, and sufficient blood is withdrawn for a count, emergency blood chemistries, and a type and cross match. Leaving the needle in place, an infusion of normal saline solution or plasma expander is begun until whole blood is available.

A nasogastric tube is then inserted in all patients except those suspected of having esophageal varicies, because of a large spleen or other evidence of cirrhosis on physical examination. This tube has three advantages: (1) decompression of the stomach, removing blood and allowing the elasticity of the gastric wall to aid in hemostasis; (2) removing acid-peptic secretions; and (3) giving evidence of the severity and activity of the hemorrhage.

A Foley catheter is also inserted if shock is present or impending, to measure urinary output accurately. The patient remains in the emergency room and is not transported until an intravenous infusion is in place, vital signs are stabilized and whole blood is available at the patient's side. We have found it advisable to have 6 units of cross matched blood available in the bank at all times. As one unit is used it should be replaced.

In the case presented herein, it was soon obvious that massive gastrointestinal hemorrhage was not a problem.

Following decompression by continuous nasogastric suction, the patient's obstructive symptoms disappeared. Epigastric distress was considerably relieved by a bland diet, antacids and antispasmodics. The substernal pain persisted, however, and was severe enough on some occasions to require narcotics. Furthermore, she had occasional dysphagia and painful deglutition. A recent weight loss of 25 pounds had no effect on her symptoms and it is doubtful if further weight reduction would be beneficial. It was thought that despite the patient's age and cardiac symptoms, operative intervention was indicated. Adequate surgical management in such a case must be aimed at correcting both the hiatus hernia and the underlying acid-peptic disease.

It has been shown that from 35 to 40 per cent of all patients with symptomatic hiatus hernias require additional abdominal surgery. In a series reported by Mobley and Christensen [1], one-fourth of the patients operated upon had associated peptic ulcer disease. Another one-fourth had chronic cholecystitis.

In the case presented herein, a transabdominal repair was performed. Because of the patient's age and general physical condition, the more conservative operations for ulcer (i.e., vagotomy and pyloroplasty) were performed. Exposure of the hiatus is greatly facilitated by using a midline incision and removing the xiphoid process.

A phrenic crush, in addition to hiatal repair, is of doubtful value. It is often permanent rather than temporary, and may encroach significantly upon the respiratory reserve. Furthermore, the left phrenic nerve supplies the left half of the right diaphragmatic crux, and its interruption may actually cause incompetence of the cardia.

SUMMARY

1. The symptomatic hiatus hernia is frequently associated with other intra-abdominal pathologic conditions, most commonly with peptic ulcer or gallbladder disease.

2. Adequate surgical management must include correction of associated surgical disease to insure against persistence of recurrence of symptoms.

3. The transabdominal approach for repair of hiatus hernia is therefore the procedure of choice in many patients. Exposure is facilitated by a midline incision with removal of the xiphoid process.

REFERENCES

1. Mobley, J. E. and Christensen, N. A. Esophageal hiatal hernia: prevalence, diagnosis and treatment in an American city of 30,000. *Gastroenterology*, 30: 1, 1956.

2. Myre, T. T., Kirklin, J. W., Anderson, H. A. and Clagett, O. T. Surgical considerations in treatment of esophageal hiatal hernia. *J. A. M. A.*, 164: 147, 1957.

Case Analysis Clinic

BLEEDING MECKEL'S DIVERTICULUM IN AN ADULT

DONALD W. TRAPHAGEN, M.D., *Columbus, Ohio*

From the Department of Surgery, Ohio State University Medical Center, Columbus, Ohio.

THE patient (O. S. U. No. 645192), a twenty-five year old white woman, was admitted to Ohio State University Medical Center on July 20, 1958, with a chief complaint of rectal bleeding. She stated that following her evening meal she noted cramping abdominal pain and within three hours passed a large quantity of dark red liquid stool. A similar episode had occurred ten months prior to this admission. At that time 8 pints of whole blood were required to replace the blood loss. Barium enema and upper gastrointestinal radiographs disclosed no abnormalities at that time. Three months prior to admission a repeat upper gastrointestinal series and barium enema were done. A "suggestion of a duodenal ulcer" was found but no ulcer niche was detected. Since that time the patient had been treated with an ulcer diet, anticholinergic drugs and antacids. No ulcer symptoms were noted, however. The rectal bleeding on both occasions was described as consisting of large quantities of dark red blood, free of clots.

Past history was non-contributory. No other manifestations of abnormal bleeding had ever occurred, and her menstrual history was normal. The usual childhood diseases had occurred without sequelae. Surgical removal of a thrombosed hemorrhoid had been performed in 1951. It was thought significant that both the mother and father had proved active duodenal ulcers.

PHYSICAL EXAMINATION

The patient was a normally developed but thin white female. She was in no acute distress but was apprehensive concerning her rectal bleeding. Blood pressure was 114/64 mm. Hg; pulse, 84; respiration, 20; and temperature, 99.2°F. Complete physical examination was of no aid in diagnosis. The patient was found to be in excellent health without demonstrable abnormality. Rectal examination disclosed dark red blood but no other significant findings.

LABORATORY DATA

Hemoglobin was 11.6 gm. per cent; hematocrit, 35 per cent; white blood count, 11,050 per cu. mm. with a normal differential count. Blood urea nitrogen was 19 mg. per cent; blood sugar, 75 mg. per cent, serologic test for syphilis negative. Urinalysis disclosed the following data: specific gravity, 1.027; sugar and protein, negative; microscopically, few white blood cells and epithelial cells.

During the previous hospital admission the following tests had been performed, all within normal limits: prothrombin, cephalin flocculation, bleeding and clotting time, platelet count, serum calcium. These tests were not repeated at this time.

MANAGEMENT

Upon admission, patients with gastrointestinal bleeding are managed in the following way: Six units of whole blood are typed and cross matched while the patient is in the emergency room. If massive hemorrhage is occurring, colloid in the form of serum albumin or dextran is given prior to obtaining the blood. An 18 gauge needle is used. A minimum of 4 pints of whole blood is kept available. Normal saline solution alone is never used in treating hypovolemic shock. Vasopressor drugs should be used only if blood replacement is ineffectual. Shock due to hemorrhage is treated by replacement with whole blood. Colloid may be used until blood is available.

Blood pressure and pulse should be recorded every fifteen minutes until all bleeding has

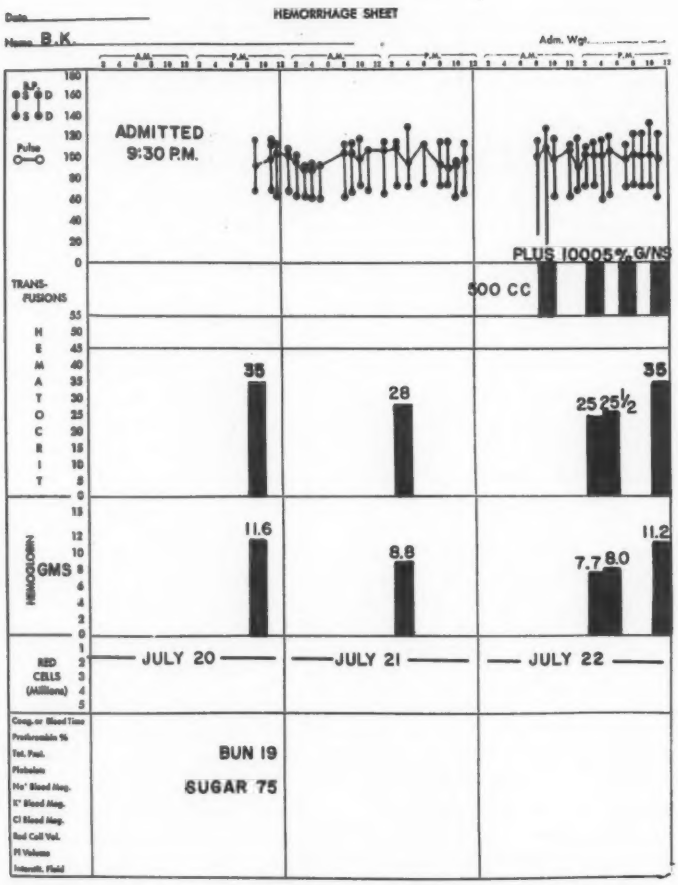


FIG. 1. Hemorrhage sheet used at University Hospital, Columbus, Ohio, depicting treatment of hemorrhage and the patient's physiological response.

ceased for at least twelve hours. Hemoglobin and hematocrit determinations are ordered every eight hours. All this information is recorded on a hemorrhage sheet. (Fig. 1.) A properly kept hemorrhage sheet which depicts the amount of blood or colloid given and the patient's physiological response is an accurate guide for the surgeon.

Soon after admission, sigmoidoscopic examination was performed. Dark red blood was found beyond the 25 cm. reach of the sigmoidoscope. Sigmoidoscopic examination is always indicated in the patient who passes blood per rectum even if the blood is black. Variations in transit time, amount of bleeding, as well as the presence or absence of obstruction, may greatly alter the color of the blood. Do not be misled by the color; *use the sigmoidoscope.*

The patient's bleeding ceased soon after admission and transfusions were not immediately required. Investigation as to the cause and location of the bleeding were begun. In view of previous negative findings from upper gastrointestinal radiographs and barium enemas, a fluorescein string test was indicated. This test, as reported by Traphagen and Karlan [1], should help locate the source of bleeding. Figure 2 depicts the equipment necessary for this test. After the patient had willingly swallowed the weighted string, she was asked to advance it by swallowing 6 inches every thirty minutes. For the first hour she was

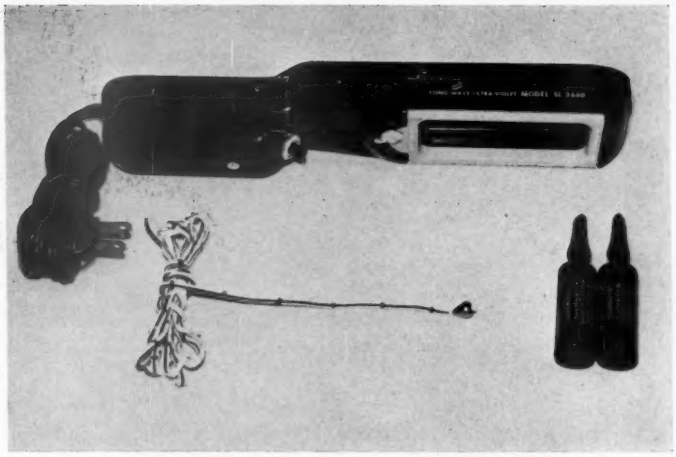


FIG. 2. Equipment necessary for performance of the string test.

placed on her right side to facilitate passage of the lead weight through the pylorus.

Twelve hours later an upright radiograph of the abdomen was obtained to locate the position of the radiopaque string. (Fig. 3.) At this time the end of the string was judged to be in the last third of the ileum. The string was then taped to the patient's cheek to prevent further movement. The nursing and house staff were alerted to watch for the first signs of repeated bleeding. The patient was continued on a bland diet to avoid negative nitrogen balance and dehydration. She ate easily with the string in place. On the evening of the third hospital day the patient passed a dark red bloody stool and experienced mild abdominal cramps. "Stat" hemoglobin and hematocrit determinations were 7.7 gm. per cent and 25 per cent, respectively. Ten cubic centimeters of sodium fluorescein were injected into an antecubital vein and the string was removed. Examination of the string proved it to be free of blood and fluorescein dye. This was absolute evidence that no bleeding was occurring within the area traversed by the string, namely, from the lips to the mid-ileum. With this new evidence, diagnostic possibilities became more limited and bleeding from a Meckel's diverticulum was seriously considered. Much has been written concerning bleeding from a Meckel's diverticulum but most reported cases occur in children. Fojcik [2] in 1957 reviewed the literature and reported an unusual case of bleeding from this source in a seventy-one year old

FIG. 3. Upright radiograph of abdomen showing string in lower ileum.

woman. When bleeding does occur, heterotropic gastric mucosa is usually found in the diverticulum. It is of interest that Mayo [3] and others have found Meckel's diverticuli to be twice as prevalent in males as in females.

At the onset of recurrent bleeding, whole blood transfusions were started. Four units of whole blood were administered in a twenty-four-hour period. At the end of that time the hematocrit was 35 per cent and the hemoglobin was 11.2

FIG. 4. Meckel's diverticulum with copious supply of blood vessels.

gm. per cent. With prompt blood replacement, no drop in blood pressure occurred despite a measured blood loss of 1,500 cc. During this twenty-four-hour period the patient was continued on a bland diet. Hemorrhage again ceased spontaneously. If blood loss had continued at the rate of 3 to 4 pints each twenty-four-hour period, emergency surgical intervention would have been indicated. Hoerr [4] and others have clearly shown the inadvisability of prolonged conservative management in the face of continued massive hemorrhage. Unless one's hand is forced, it is advantageous to know the source of bleeding prior to surgical intervention. In this case the string test clearly established the bleeding point as distal to the mid-ileum. With this knowledge, x-ray films of the stomach and small bowel were obtained. No abnormality was detected. Only occasionally is a Meckel's diverticulum found by radiographic methods, and then most commonly by chance rather than intent.

The patient was placed on a low residue diet, and was given 1 gm. of neomycin every six hours and 2 ounces of castor oil twice daily. Even though a tentative diagnosis of Meckel's diverticulum had been made, preparation of the colon was mandatory to allow for colotomy and "sterile coloscopy" if the source of the bleeding was not found in the ileum. The use of a sterile sigmoidoscope through multiple colotomy incisions should always be anticipated if the bleeding originates in the lower portion of the small bowel or large bowel.

On July 25, the fifth hospital day, an incision was made in the lower right quadrant to expose the ileocecal area. A large Meckel's diverticulum was encountered (Fig. 4.) A mesentery to the diverticulum was present with a large artery coursing down its edge. The tip of the diverticulum was firm and somewhat suggestive of a tumor. Prior to resection of the diverticulum, general exploration of the abdomen had shown no abnormalities. Frozen section diagnosis of the resected diverticulum was heterotropic gastric mucosa. No evidence of neoplasm was found. The ileum was closed transversely to prevent obstruction of the lumen.

POSTOPERATIVE COURSE

The postoperative course was without unusual incident. The patient's hemoglobin and hematocrit remained stable and she was free of abdominal cramps. She was discharged on the seventh postoperative day and has remained in good health, free of abdominal cramps and without recurrent bleeding for seven months.

SUMMARY

The management of the patient with massive gastrointestinal hemorrhage due to a Meckel's diverticulum is discussed. The fluorescein string test is helpful in localizing the source of hemorrhage to the region of the distal ileum.

REFERENCES

1. TRAPHAGEN, D. W. and KARLAN, M. Fluorescein string test for localization of upper gastrointestinal hemorrhage. *Surgery*, 44: 644, 1958.
2. FOJCIK, K. J. Meckel's diverticulum as a source of hemorrhage. *Am. J. Surg.*, 94: 632, 1957.
3. MAYO, C. W. and REMINGTON, J. H. Acute surgical conditions of the abdomen; congenital lesions. *Collect. Papers Mayo Clin. & Mayo Found.*, 38: 138: 1946.
4. HOERR, S. O. Management of upper gastro-intestinal hemorrhage. *New England J. Med.*, 248: 404, 1953.

Our Surgical Heritage

D. P. HALL, M.D., *Surgical Department, University of Louisville, Louisville, Kentucky*

UNITED STATES OF AMERICA

JOHN SYNG DORSEY

JOHN SYNG DORSEY was born on December 23, 1783, in Philadelphia where his father Leonard Dorsey was a successful merchant. He was the nephew of an illustrious man, Philip Syng Physick. Dorsey received the degree of Doctor of Medicine in 1802 from the University of Pennsylvania at the age of nineteen and was appointed a resident physician at the City Hospital. It was here that he performed many autopsies and made careful bedside observations before death to correlate his findings.

In 1803 Dorsey embarked on a European sojourn with the avowed intention of spending a great part of his time in two great medical centers, London and Paris. While in London he lived with John Hunter and worked in Hunter's private dissecting room as had his uncle, Philip Syng Physick, before him. He attended Hunter's anatomical school where he acquitted himself well. In June 1803 he journeyed to Paris, and through the kindness of Boyer, then the surgeon-in-chief of La Charité, he received permission to continue dissection in the "Salle de Repos." In his diary he gives not one line to the great French surgeons, Dupuytren or Bichat, but does indite a line expressing his opinion thusly, "As to French surgery, I have learned nothing from it."

The year 1804 saw the return of Dorsey to Philadelphia where he entered the practice of surgery and was appointed adjunct professor of surgery at the University of Pennsylvania. Withal, in 1807 he found time to help his illustrious uncle Dr. Physick.

His greatest contribution to surgery was his textbook "Elements of Surgery" published in 1813, with most of the illustrations drawn by the author. This textbook received world-wide recognition and the down-to-earth surgical principles could well be read by many modern surgeons.

Dorsey married Maria, daughter of Robert Ralston, a Philadelphia merchant, in 1807 and became the father of a son and two daughters.

Dorsey was a very religious man and had the soul of a poet. He died in 1818 at the early age of thirty-five from typhus fever, and his last words were, "I have a desire to live and remain with my family, but my desire to be with Christ is far greater."

EUROPE

JOHN ABERNETHY

JOHN ABERNETHY was born in London on April 3, 1764. He had an early bias toward the bar and seems to have drifted into surgery almost by accident. In 1779 he was apprenticed to Sir Charles Blicke, an assistant surgeon at St. Bartholomew's Hospital. At the age of twenty-three he was elected assistant surgeon at St. Bartholomew's Hospital but had to wait for twenty-eight years before he became a full staff surgeon at this institution. Abernethy, like many of his fellow surgeons, based his surgical work on human anatomy but used it only as a stepping stone and a guide to physiology. It must be said that he was probably the world's first great physiologic surgeon. The surgical arena at London in Abernethy's time was about equally shared with Astley Cooper. Both men studied with John Hunter and were probably his most famous pupils, yet they were opposite in their reactions to the public. The great success of Abernethy as a surgeon in London must be directly attributed to his personality. Although his appearance was ordinary, he was whimsical and caustic.

Mr. Abernethy's lectures at St. Bartholomew's Hospital were so popular that a building was erected in 1790 where he might carry on his teaching. Because of this he has been considered by many as a founder of St. Bartholomew's Medical School. His medical students thought of him as a clear, forceful and very dramatic teacher. He carried on much in the spirit of John Hunter by conducting numerous anatomical and physiological experiments in the laboratories, which to a great degree were his brain children. He was appointed professor of anatomy and surgery in the Royal College of Physicians of England, to which Chair he brought much luster. His contributions to surgery were many. He was first to ligate the external iliac artery for aneurysm in 1796; this operation he performed four times, twice with success. He ligated the common carotid artery for hemorrhage in 1798 and advocated the incision of lumbar abscesses as the best and most curative treatment for this condition. In 1793 he described an anomaly of the viscera which must now be considered an Eck fistula.

Although Abernethy was a kindhearted and generous man, he had a brusque, downright manner with his patients, this being on the assumption that masterful rudeness begets confidence, whereas friendliness might suggest weakness and diminish respect.

John Abernethy died at Enfield, England, on April 20, 1831. It has been stated that the greatest contribution of his life was "the inspiration which he gave to medical teaching at St. Bartholomew's and throughout England."

Book Reviews

Callander's Surgical Anatomy. By Barry J. Anson, M.D., M.A., PH.D. (Med. Sc.) and Walter S. Maddock, M.S., M.D., F.A.C.S. Fourth edition, 1157 pages, 1047 illustrations. W. B. Saunders Co. Philadelphia, 1958. *Price* $21.00.

This is a handsome new edition of a standard and widely accepted text. It is the fourth edition since its first appearance in 1933, and the second revision presented by the present authors. The original format of Dr. Callander has been preserved, organizing anatomy into the topographic regions and organs of practical surgical interest. Structure, blood supply, innervation and lymphatic drainage are discussed together. The text has grown to include considerable basic physiology as well. The illustrations are profuse, numbering over 1,000, and of good quality, although sometimes a little small. A number of fundamental operative procedures are well drawn, but the emphasis is placed on structure and function rather than on changing operative technics. The result is a thoroughly interesting presentation of basic anatomic information, in sufficient detail for reference and organized for practical application.

DANIEL W. ELLIOTT, M.D.

Cold Injury, Ground Type. By Col. Tom F. Whayne, MC, USA (Ret.) and Michael E. De Bakey, M.D. 570 pages. Office of the Surgeon General, Department of the Army. Washington, D. C., 1958. *Price* $6.25.

This is the most recently published volume in the series dealing with the official history of the Medical Department of the United States Army in World War II. It is without doubt the most completely detailed work on the ground type of cold injury which has ever been published. It is probably as complete a book on any circumscribed topic as has ever been published. To the civilian reader without combat experience in modern warfare it will be impressive for its detailed analyses, objective treatment and logical conclusions. It is, however, somewhat heavygoing in view of the infrequency with which the problem is encountered in civilian practice. To the military surgeon it represents the best and most complete treatment of a vital problem. How vital this problem is in wartime may be seen from the fact that the total number of cases of cold injuries of all types during World War II approximated 91,000, and the total time lost has been estimated as above seven and a half million man-days. In the European theater in the winter of 1944–1945, the ratio of cold injury to battle injury in United States forces was above 1:4. The lessons learned at such enormous cost must not be lightly disregarded and this volume represents, therefore, a real contribution to civilian surgery and a monumental contribution to military surgery. If not read from cover to cover, it should at least be examined and an awareness of its availability well noted.

ROBERT N. WATMAN, M.D.

An Introduction to Surgery. Edited by David H. Patey, M.S. (Lond.) F.R.C.S. (Eng.). 228 pages. Year Book Publishers, Inc. Chicago, 1958. *Price* $3.00.

As is typical of our British colleagues, this book on the examination of the surgical patient is well written in a precise, clearly understandable manner. With the use of line drawings, the fundamentals of a comprehensive examination are explained as part of general medicine rather than as a technical art. The sections on metabolic problems, injuries to the head, and pre- and postoperative care are typical of the excellent quality of the book. The examination of the patient is then divided into organ systems for specific details. The more common minor surgical procedures are described under the heading of "Practical Procedures." We find this book, with its well organized presentations, handy small size and inexpensive paper binding, to be an ideal text for an introduction to surgery.

CHARLES V. MECKSTROTH, M.D.

Eye Surgery. By Rev. H. B. Stallard, M.B.E., M.A., M.D. (Cantab.), F.R.C.S. (Eng.), Hon. LL.D. (St. Andrews). Third edition, 899 pages, 671 illustrations. The Williams and Wilkins Co. Baltimore, 1958. *Price* $18.00.

This is a large text which covers the field of eye surgery thoroughly. The material is presented in detail, and is quite adequate as a reference for the practicing ophthalmic surgeon. The trainee will do well to read thoroughly a book of such scope during his residency. The author has included up-to-date details on scleral resection, corneal transplantation, technics of cataract removal and many other topics. The section on plastic surgery about the eye is particularly good. The author has avoided the presentation of multiple obsolete operations of historical value only, and has thereby produced a book which will be as deservedly popular as the two earlier editions.

WILLIAM H. HAVENER, M.D.

Head Injuries. Mechanisms, Diagnosis and Management. By E. S. Gurdjian, M.D. and J. E. Webster, M.D. 482 pages. Little, Brown & Co. Boston, 1958. *Price* $14.00.

This comprehensive text is introduced by a historical review of the subject from archeological findings and the Edwin Smith papyrus to the present. The authors' wide experience with both the clinical and experimental aspects of the subject is evident. Their work on skull fracture and the mechanisms of brain injury is presented. Investigative technics are well illustrated, from the use of careful clinical observation of patient or animal, through the more complex mechanical, biochemical and electrophysiologic technics.

The clinical aspects of the problem are thoroughly covered. In addition to the classic problems of compound fractures and intracranial bleeding, the more unusual sequelae of open or closed injury to the head are discussed in detail. A discussion of cervical injuries due to hyperextension and hyperflexion is included. Chapters on injuries to the head in sports and the medicolegal aspects of them are of particular interest. A useful chapter is devoted to the management of the comatose patient.

The book should have wide appeal for student, investigator and clinician. All pertinent questions are raised, if not answered. The detailed bibliography provides an open door to the thinking of many men. The authors do not hesitate to express their convictions in controversial areas, theoretical, clinical and forensic. Obviously, other physiologists and neurosurgeons will not always agree with the authors' conclusions, but the book provides an excellent frame of reference for further clinical and experimental advances.

WILLIAM HUNT, M.D.

Annals of the New York Academy of Sciences. Surgical Convalescence. Editor in Chief, Otto V. St. Whitelock. Consulting Editor, F. Curtis Dohan. Vol. 73, Art. 2, pages 381–538. Published by the Academy. New York, 1958. *Price* $4.00.

This volume of approximately 150 pages contains an amazing proportion of what is known, and what is not known, about convalescence after surgery. There is an introduction by Dr. I. S. Ravdin with a brief description of the problem and its history. Sixteen articles follow concerning various phases of convalescence, each by an author whose name is identified with the specific topic. Much of the material has been published in the surgical literature in one form or another.

At any rate, this is a remarkably complete and compact volume covering the physiology and pathology of convalescence and its clinical, economic, social and psychological implications. It is well worth the careful attention of every physician, surgeon, student and house officer.

R. N. WATMAN, M.D.

Physical Diagnosis: The History and Examination of the Patient. By John A. Prior, M.D. and Jack S. Silberstein, M.D. 388 pages, 193 illustrations. C. V. Mosby Co. St. Louis, 1958. *Price* $7.50.

By means of a concise yet complete approach to physical diagnosis, the authors have obtained their objective. The technics of the history and physical examination are presented in lucid language augmented by excellent illustrations. In addition, the orientation of the medical student is completed by discussion of doctor-patient relationship, and professional attitude and behavior. The various aspects of the history and physical examination are covered in fifteen chapters by various members of the faculty at Ohio State University. The chapter on medical history is written by the authors. The chapters on general inspection, cardiovascular system and the extremities are by Dr. Silberstein. Dr. Prior contributes the chapters on head, face and neck as well as thorax and lungs. Examination of the eyes is described by Dr. William H. Havener, Associate Professor of Ophthalmology,

and the ears, nose and throat chapter is done by Dr. William H. Saunders, Associate Professor of Otolaryngology. Procedures for the examination of the breast are described by Dr. Arthur G. James, Associate Professor of Surgery, and examination of the abdomen and male genitalia by Dr. Floyd M. Beman, Associate Professor of Medicine (Gastroenterology). The examination of the female genitalia is described by Dr. William E. Copeland, Assistant Professor of Obstetrics and Gynecology. Dr. Dwight M. Palmer, Professor of Medicine (Neurology) contributes the chapter on examination of the nervous system, while Dr. William S. Smith, Associate Professor of Surgery (Orthopedics), describes the examination of the motor-skeletal system. The final chapter by Dr. Earl H. Baxter, Professor of Pediatrics, covers the examination of the infant and child.

Thus a well organized approach to physical diagnosis by a team of experts results in a dynamic, concise book containing superb illustrations. This book, although intended for the young medical student, would be a valuable addition to the library of any practicing physician who wishes to refresh or maintain the basic tools of his profession.

Introduction to Urology. By Frank C. Hamm, M.D., M.S., F.A.C.S. and Sidney R. Weinberg, M.D., F.A.C.S. 293 pages. Dept. of Surgery, University of the State of New York, Downstate Medical Center. Brooklyn, 1958.

This book has been written specifically for the medical student. Even though in loose-leaf form, it is beautifully printed and should be as durable as any well bound book.

Coverage and presentation of fundamental pertinent information in urology is broad and excellent. Language is concise and easy to grasp. Controversial material has largely been omitted.

Each chapter gives proper emphasis on pertinent embryology, anatomy, physiology, etc., as is needed. The organization of material is good and individual subtopics are easily found due to appropriate bold print. Subject matter is augmented generously throughout with diagrams, excellent illustrations and prints of well chosen roentgenograms. An adequate bibliography is appended to each chapter.

This is a very fine text for the medical student and a good reference book for him in the postgraduate years of practice.

JACK N. TAYLOR, M.D.

Physical Examination of the Surgical Patient. By J. Englebert Dunphy, M.D., F.A.C.S. and Thomas W. Botsford, M.D., F.A.C.S. Second edition, 375 pages, 203 illustrations. W. B. Saunders Co. Philadelphia, 1958. *Price* $8.00.

One of the most common deterrents to the proper care of a surgical patient is an inadequately performed or improperly interpreted physical examination. There is no better way to avoid these pitfalls than to have a sound foundation in the fundamentals of examination of the surgical patient. Drs. Dunphy and Botsford have left no stone unturned in this clearly written and finely illustrated text. This second edition has all the completeness of the first edition plus new chapters on "cancer detection" and "history taking." Material has been added to other chapters, especially those on the head and neck, and peripheral vascular disorders. It would be hard to find a more practical teaching tool than the seventy pages on "examination of the abdomen." This book is a perfect companion for the medical student or any physician wanting to improve his skill in this basic art of surgery.

CHARLES V. MECKSTROTH, M.D.

Doctor Squibb. By Lawrence G. Blochman. 371 pages. Simon & Schuster. New York, 1958. *Price* $5.00.

There can be no doubt about Dr. Squibb's contributions to American pharmacy and pharmaceutical manufacturing. He was an uncompromising perfectionist and a fighter. He set and met standards of accuracy and purity for the industry and contributed a good deal to the U.S. Pharmocopeia. The Pure Food and Drug Act, to a degree at least, resulted from his fight.

Squibb, the physician and pharmacist, and his medical and pharmaceutical age were interesting indeed; Squibb the man, much less so. The volume unfortunately is disproportionately weighted by material about Squibb the man. There are multitudes of personal minutiae, mostly culled from the doctor's diaries. These are not of intrinsic interest and greatly dilute the material which is.

ROBERT N. WATMAN, M.D.

Water and Electrolyte Metabolism in Relation to Age and Sex. Edited by G. E. W. Wolstenholme, O.B.E., M.A., M.B., B.CH. and M. O'Connor, B.A. Little, Brown & Co. Boston, 1958. *Price* $8.50.

Eighteen current and original papers on the regulation of body water and electrolytes are

presented in full. These were prepared for the fourth colloquium on the problems of aging, sponsored by the Ciba Foundation in London in 1958. Twenty-seven authorities from nine nations took part, the majority from Great Britain and the U. S. A.

Each paper summarizes current knowledge of some aspect of this important field, including the author's experimental data in detail, and is followed by some fairly lively and critical discussion. Most of the papers concern basic physiologic processes studied in rats. However, the section on water and electrolyte metabolism in congestive failure reports studies of particular clinical value in patients.

The papers are too detailed and voluminous to serve as a reference for students or clinicians. However, this volume contains important and useful information for everyone working in this rapidly developing area of research.

DANIEL W. ELLIOTT, M.D.

Surgery of the Head and Neck. A Handbook of Operative Surgery. Robert A. Wise, M.D. and Harvey W. Baker, M.D. Illustrated by Jessie W. Phillips. 319 pages. Year Book Publishers, Inc. Chicago, 1958. *Price* $9.75.

This is a comparatively small book of a little over 300 pages. It covers the field of head and neck surgery in a concise, up-to-date and practical, adequate manner. There are eighty-two illustrations which serve to emphasize points of technic. The material is well organized and should serve as a ready reference for the desk of the surgical house staff or for the library of the practicing surgeon.

ARTHUR G. JAMES, M.D.

BOOKS RECEIVED FOR REVIEW

All books received will be acknowledged in this column. Insofar as possible, as space permits, books of special interest will receive more extensive reviews.

Synopsis of Obstetrics and Gynaecology. Aleck W. Bourne, M.A., M.B., B.CH. (Camb.), F.R.C.S. (Eng.), F.R.C.O.G. Twelfth edition, 632 pages. John Wright & Sons, Ltd. Bristol, Eng., 1959. *$8.00.*

The Surgical Treatment of Facial Injuries. Varaztad Hovhannes Kazanjian, M.D., D.M.D. and John Marquis Converse, M.D. Second edition, 1110 pages. Williams & Wilkins Co. Baltimore, 1959. *$22.00.*

Symposium on Pulmonary Ventilation. Edited by R. P. Harbord, M.D. and Prof. R. Woolmer. 109 pages. Williams & Wilkins Co. Baltimore, 1959. *$4.00.*

Experimental Surgery, Including Surgical Physiology. J. Markowitz, M.B.E., M.B., PH.D., M.S., J. Archibald, D.V.M., M.V.SC. and H. G. Downie, D.V.M., M.S. Fourth edition, 931 pages. Williams & Wilkins Co. Baltimore, 1959. *$12.50.*

Clinical Disorders of Hydration and Acid-Base Equilibrium. Louis G. Welt, M.D. Second edition, 336 pages. Little, Brown & Co. Boston, 1959. *$7.00.*

Metabolic Homeostasis. A Syllabus for Those Concerned with the Care of Patients. N. B. Talbot, M.D., R. H. Richie, M.D., and J. D. Crawford, M.D. Harvard University Press. Cambridge, 1959.

Clinical Prosthetics for Physicians and Therapists. A Handbook of Clinical Practices Related to Artificial Limbs. Miles H. Anderson, ED.D., Charles O. Bechtol, M.D. and Raymond E. Sollars. 393 pages. Charles C Thomas. Springfield, Ill., 1959.

Metabolic Care of the Surgical Patient. Francis D. Moore, M.D. Illustrated by Mildred Codding. 1011 pages. W. B. Saunders Co. Philadelphia, 1959. *$20.00.*

Biopsy Manual. James D. Hardy, M.D., James C. Griffin, Jr., M.D. and Jorge A. Rodriguez, M.D. 150 pages. W. B. Saunders Co. Philadelphia, 1959. *$6.50.*

Cancer of the Breast. Edited by Willard H. Parsons, M.D., F.A.C.S. 232 pages. Charles C Thomas. Springfield, Ill., 1959.

Human Nutrition and Dietetics. Sir Stanley Davidson, B.A., M.D., F.R.C.P., A. P. Meiklejohn, M.A., B.SC., D.M., M.R.C.P. and R. Passmore, M.A., D.M. 844 pages. Williams & Wilkins Co. Baltimore, 1959. *$15.00.*

Clinical Neurosurgery. Proceedings of the Congress of Neurological Surgeons. Volume 6, 289 pages. Williams & Wilkins Co. Baltimore, 1959. *$11.00.*

Upper Digestive Tract. (Part 1, Volume 3 of Digestive System. The Ciba Collection of Medical Illustrations.) Edited by Ernst Oppenheimer, M.D. Prepared by Frank H. Netter, M.D. 206 pages. Ciba Pharmaceutical Products. Summit, N. J., 1959. *$12.50.*

Planning Homes for the Aged. Prepared and edited by Geneva Mathiasen and Edward H. Noakes. 128 pages. F. W. Dodge Corp. New York, 1959. *$12.75.*

Pain and Itch, Nervous Mechanisms. Ciba Foundation Study Group No. 1. 120 pages. Little, Brown & Co. Boston, 1959.

Steric Course of Microbiological Reactions. Ciba Foundation Study Group No. 2. 115 pages. Little, Brown & Co. Boston, 1959.

The Surgical Treatment of Scoliosis. Louis A. Goldstein, M.D., F.A.C.S. 116 pages. Charles C Thomas. Springfield, Ill., 1959. *$6.75.*